Cost-Volume Relationships for New Country Elevators in the Corn Belt

Stanley K. Thurston
and R. J. Mutti

FARMER COOPERATIVE SERVICE
U. S. DEPARTMENT OF AGRICULTURE

In cooperation with the University of Illinois

Service Report 32

September 1957

The Farmer Cooperative Service conducts research studies and service activities of assistance to farmers in connection with cooperatives engaged in marketing farm products, purchasing farm supplies, and supplying business services. The work of the Service relates to problems of management, organization, policies, merchandising, product quality, costs, efficiency, financing, and membership.

The Service publishes the results of such studies, confers and advises with officials of farmer cooperatives; and works with educational agencies, cooperatives, and others in the dissemination of information relating to cooperative principles and practices.

Joseph G. Knapp,
Administrator,
Farmer Cooperative Service,
U. S. Department of Agriculture.

This study was conducted under authority of the Agricultural Marketing Act of 1946 (RMA, Title II).

C O N T E N T S

HIGHLIGHTS

This study provides guides for country elevator management in the Corn Belt considering the construction or acquisition of new elevator facilities. The elevator model approach was used to show costs for selected sizes and types of operations containing new elevators and operating at various storage and handling volumes. Basic data for developing such elevator models and costs were obtained from case study analyses of representative cooperatively-owned country grain elevators, from previous elevator business studies, and from elevator building contractors.

Many old or inefficient grain elevators need to be replaced with new elevators or overhauled to increase efficiency. In other instances, additional grain storage facilities are needed. Such modernization can reduce costs and provide better service for farm patrons. In planning a modernization program, the amount and quality of farm storage as well as competitive commercial storage must be considered.

The seasonality of total grain receipts, which is influenced by the kind and amounts of grains marketed in an area, exerts an important effect upon operating practices, policies and costs of elevators. The handling volume may be increased by the many kinds of grains because it spreads the volume over a longer period. On the other hand, storage utilization may be hampered because the capacity must be vacated to make room for an oncoming harvest. When more than one kind of grain is received, there is need for a greater number of bins, some of which may be only partially filled.

Elevator Models

The elevator models used consisted of representative new elevators being built in the Corn Belt plus an old elevator. In addition, each model was assumed to have $100,000 sideline volume of feed, seed, fertilizer, and building supplies.

Construction costs at the 1956 level were determined for each new facility. Local labor used in construction was based on a local wage rate. The total cost of constructing concrete elevators varied from $1.96 a bushel for the 30,000-bushel elevator to 61 cents a bushel for the 400,000-bushel model.

Equipment costs for concrete facilities were somewhat fixed regardless of capacity; thus, equipment cost per bushel of capacity declined sharply as size of elevator increased. In contrast, building costs per bushel declined only moderately as size of elevator increased.

Concrete tanks were cheaper to build than complete concrete elevators because they utilized the headhouse and leg of an adjacent old elevator and had fewer bins. Construction cost of four 25,000-bushel concrete tanks, including necessary equipment, totaled 50 cents a bushel compared to 73 cents

a bushel for the 100,000-bushel concrete elevator. Compared to concrete elevators, concrete tanks have less flexibility, generally have lower storage utilization, and the opportunity for "breakdowns" is greater.

Of all types of construction used in the model facilities, flat storage was by far the cheapest to build because of the materials used, method of construction, and the absence of expensive equipment. Two 55,000-bushel flat steel structures cost 34 cents a bushel including aeration, temperature detecting, and portable conveying equipment.

The primary function of flat structures is for grain storage;however, such buildings can readily be adapted to other uses. Although construction costs are lower, grain handling costs are higher than for other types of storage because of the methods used to receive and load out grain. Only dry grain should be put in flat storage. As an additional precaution against quality deterioration, it is generally advisable to install aeration and temperature detecting equipment.

Sideline operations in conjunction with a grain elevator offer an opportunity to absorb excess or idle inputs associated with the grain operation, and thereby contribute to greater operating efficiency for the grain functions. In providing the additional services to farmer patrons, sidelines create an opportunity to gain additional grain volume from the same farmers who purchase sidelines. In this respect, grain and sidelines are complementary.

Budgeting Costs

Several general assumptions were made in budgeting costs. The most important overall consideration was maintaining comparable cost relationships between elevator models. Facilities of the same type were assumed to be equal in quality of material, equipment, and design. All elevator models were assumed to operate in the same economic environment. The quality of all inputs--such as labor, repairs, power, and insurance for a given type and size of elevator--were assumed to be representative of the better-managed elevators.

Base volumes handled and base volumes stored were established for each elevator model to provide levels at which costs could be compared between models, and to provide a base from which to budget individual expense items at other volumes for a given elevator.

The assumed distribution of storage utilization for concrete model elevators was 38 percent corn, 5 percent oats, 9 percent wheat, and 48 percent soybeans. The assumed distribution of grain handled was 59 percent corn, 6 percent oats, 13 percent wheat, and 22 percent soybeans.

At base volumes, fixed expenses comprised 36 to 46 percent of the total expense for the various elevator models, while variable expenses made up 54 to 64 percent of the total. Depreciation was the largest fixed expense item. Personnel expenses made up 34 to 43 percent of total expenses,

and other variable expenses comprised 16 to 23 percent for the various elevator models. At volumes above the base, total personnel and other variable expenses increased in importance as compared to total fixed expenses.

Findings

Cost-volume relations were analyzed for various sizes and types of elevator structures as reflected in the elevator models. The findings are herewith presented in two sections. The first section of findings emphasizes the cost-volume relations with respect to size of facility, whereas the second section deals with type of facility.

Size of facility

1. At the base volume levels assumed, the lowest costs per bushel were found with the larger size facilities--both in merchandising and handling and in storage. The larger facility had a greater dollar and cent advantage per bushel over the small facility in storage than in merchandising and handling operations.

2. When operating at one-half base merchandising and handling volumes, the absolute difference in unit costs between small and large facilities of the same type was greater than at base volumes and the advantage of the larger over the smaller facilities increased. This relationship was also true for the storage function but to a lesser extent.

3. From the standpoint of operating costs, the different size elevators each had their own particular advantages and disadvantages. Size of the elevator and percent of capacity utilized affected many fixed and variable expenses. Cost of the elevator directly affected only fixed expenses.

4. Unit costs for fixed and variable expenses changed at different rates. Fixed costs per bushel handled or stored generally declined sharply with volume increases, while variable costs per bushel declined at a moderate rate. As a result variable costs per bushel handled or stored became relatively larger than fixed costs as volume increased.

5. The larger elevators were at a serious disadvantage from the standpoint of fixed cost per bushel at similar lower volumes. As handling volume increased, the per bushel cost differences between different size elevators became less. High fixed costs might mean that an elevator must handle or store additional volume in order to bring costs to competitive levels. On the other hand, small elevators were at a disadvantage on fixed costs compared with competitive elevators of larger size when both were handling and storing at their base volumes. In addition, small elevators were more limited in the service they could provide farmers because of their small capacity.

6. Variable expenses per bushel for the larger elevators were only slightly higher than for the smaller elevators at a given volume. At the higher volume levels this difference became even less. Such variable expenses were higher for the larger models because they were geared to handle greater volumes as required and at the lower volume they had excess expense inputs that a smaller elevator did not have.

For the merchandising and handling function, variable costs were relatively more important than fixed costs, since that function made relatively light demands upon total facilities. A heavier demand upon facilities was made by the storage function; consequently, for the storage function, fixed costs were relatively more important than variable costs.

7. Employee requirements, responsibilities, and wages increased with the increase in the size of elevator and volume handled. The regular personnel requirements of the elevator models ranged from two to five employees including the manager.

Personnel expense as the major variable expense was extremely important from the standpoint of unit costs. Personnel costs comprised a larger proportion of total costs for the merchandising and handling function than for the storage function. The performance of the merchandising and handling function was the primary reason for having personnel, whereas the storage function required relatively high fixed costs associated with the elevator buildings and equipment and low personnel expense.

8. Merchandising and handling expenses comprised the major portion of total expenses. Grain storage expense increased in relative importance as size of elevator increased, since the purpose of additional capacity was primarily for storage. Sideline expenses for the study models were held constant.

9. Important costs usually not shown on operating statements include shrinkage, quality deterioration, and interest on long-term capital. At base volumes, these expense items amounted to 4.63 cents a bushel stored for the 100,000-bushel model and 4.29 cents for the 400,000-bushel model. Of these expenses, interest on long-term capital contributed the major portion charged to the storage function. Such expenses charged to the merchandising and handling function for these same elevator models amounted to about 1 cent a bushel. Thus, these costs cannot be ignored in planning the purchasing, selling, and storing operations.

10. When different size facilities are able to handle a given volume, the facility whose highest share of capacity is used generally has the lowest cost per bushel. The study showed this advantage was greater on a cents per bushel basis for storage operations than for merchandising and handling. Thus an ever present goal is to use available facilities as near capacity as possible.

11. Economy in volume handled, as well as in service, plays an important role in determining the competitive situation for a country grain elevator. Costs per bushel stored or handled generally decreased with increases in volume. In comparing the different elevator models handling the same volume, handling costs per bushel were greatest for the larger elevators. The larger concrete elevators had to handle and store considerably greater volumes than the smaller elevators of the same design and type in order to have the same unit costs. Because of this relationship between volume and cost, it is important that the best possible estimate be made of expected volume before building. Pricing, convenience, and service rendered to patrons are also important from a competitive viewpoint.

12. Storage volume and capacity had opposite effects upon storage costs per bushel. For a given elevator, storage costs per bushel decreased rapidly with increases in storage volume; whereas, between elevator models, storage costs for a given volume increased as elevator capacity increased. At base or maximum storage levels, the larger elevator models generally had a lower cost of storage per bushel. Generally speaking, for reasonable economy in the storage of grain, the new elevator should have a minimum capacity of 100,000 bushels.

13. Addition of new equipment to present facilities will result in higher fixed expenses, but fixed cost per bushel can be reduced if the added equipment results in a great enough increase in volume handled to offset the additional expense.

Addition of a grain dryer could increase annual fixed costs by as much as $2,400. If only 100,000 bushels were handled, the fixed cost per bushel associated with the dryer would be 2.4 cents compared to four-tenths of a cent at 600,000 bushels of volume.

14. If future construction costs should rise by as much as 30 percent, merchandising and handling costs would increase four-tenths of a cent for the 100,000-bushel model and one-third of a cent for the 400,000-bushel model at base volumes. In order for the 100,000-bushel model to maintain a 6-cent handling cost, an additional 30,000-bushel handling volume would be required; the 400,000-bushel model would need an additional 50,000 bushel volume. When facility costs increase, more handling volume is required to maintain a given cost level in the larger elevators than in the small less expensive elevators.

A 30 percent increase in facility costs would have a greater effect upon storage costs than upon merchandising and handling costs. At base storage levels, storage costs for the 100,000-bushel elevator model would increase 2.51 cents compared to 2.30 cents for the 400,000-bushel model. The larger elevator would require the greater additional storage volume to maintain the unit storage costs existing prior to the 30 percent increase in facility values.

Type of facility

1. Concrete tank and flat storage type structures are less flexible than concrete elevators and less able to handle a larger volume on a daily or seasonal basis primarily because they have fewer bins and a slower receiving rate. Thus, service may be sacrificed for lower operating costs.

2. At the assumed base storage levels for three different types of facilities with similar capacity, the flat steel facility had lower costs than the concrete elevator, and the latter had lower costs than the concrete tanks. (The utilization of the flat steel space was assumed to be one-third greater than in the concrete tank and concrete elevator models.)

At the assumed base volume levels, the flat steel facility had higher merchandising and handling costs than the concrete tanks, and the latter had higher costs than the concrete elevator. (It was assumed that the concrete elevator would handle 100 percent more grain and the concrete tanks a third more grain than the flat facility.)

3. At only one-half the assumed base volume levels, the flat steel facility was at a slightly greater disadvantage in merchandising and handling operations than at the base volume.

In storage operations in which the base storage level was reduced one-half, the advantage of the flat steel over the concrete facilities narrowed.

4. At the same volume levels for each facility, the flat steel facility had lower merchandising and handling costs than the concrete tanks, which in turn had lower costs than the concrete elevator. With identical storage volumes, the concrete elevator had lower costs than the concrete tanks, and the tanks lower costs than the flat steel facility. This reversal of position was due to the way costs were allocated between storage and merchandising operations.

Cost-Volume Relations for New Country Elevators

Stanley K. Thurston
Marketing Division
Farmer Cooperative Service
and
R. J. Mutti
Associate Professor of Marketing
University of Illinois

The study reported on here provides basic cost information for country grain elevators in the Corn Belt considering new elevator facilities. They need such cost information for the long term planning associated with the acquisition of new facilities of different types and sizes.

Operating costs and other information for this study were collected from representative cooperative country elevators in Illinois. The relative effect that size if facility and volume of grain have upon the unit costs of storing and handling grain received the major emphasis during the study. Since storage and handling operations are distinctly different, this report shows relationships between cost, volume, and size for the storage function and the merchandising and handling function, separately. Elevator management can use these relationships as guides to help evaluate their own situation.

New elevator structures and equipment represent a large investment on which returns will normally be spread over a long period of time. The fixed costs associated with elevator facilities generally remain constant regardless of the grain volume handled or stored. Since new elevator facilities are very costly and may be used from 30 to 50 years, type and size are important considerations. This study can help management in their decision to build elevators most suitable and adaptable for the future.

METHOD OF STUDY

The elevators selected for case study analysis represented as nearly as possible the most important size and type situations found among elevators in the Corn Belt. Studies of the Agricultural Economics Department and the Extension Service of the University of Illinois were among the sources used as a basis for selecting these representative elevators from among all of the cooperatively-owned elevators in the State.

Note: Material credit is due Thomas E. Hall, formerly Chief, Grain Branch, Farmer Cooperative Service, and now Chief, Special Crops Branch, Federal Extension Service, for his work in guiding the study in its earlier phases and making case study analyses. Acknowledgment is also given to Dr. C. P. Schumaier, associate professor of marketing, University of Illinois, and to Walter K. Davis, formerly of Farmer Cooperative Service, and now Agricultural Attache, Foreign Agricultural Service, for their assistance in making case study analyses.

An intensive case study analysis gave operational costs of each of the selected elevators. Actual expenses and cost rates came from the financial and operating statements, elevator records, and managers of these elevators. Plant layout, labor distribution between functions, and labor efficiency were studied. Labor and power inputs were determined by actual observation at selected seasons. Data on grain receipts, shipments, and inventories were collected to help determine storage utilization and handling load.

Operating costs for synthetic operational elevator models were developed from the cost data and operating information of the case study elevators. The year 1956 was used in portraying costs and cost-volume relationships. The capacity of the new elevator models ranged from 30,000 to 400,000 bushels. Expenses were budgeted for each model at varying volumes handled and stored. The appendix contains an explanation of how these expenses were built up.

In these models, certain factors have been held constant, or fixed, as though all elevators were located in the same economic environment. Thus, cost differences associated with area differences in rates have been eliminated.

Each expense item was allocated between sideline, storage, and handling functions on the basis that seemed most logical. An important guiding principle in the allocation was to consider merchandising and handling as the primary function. Storage and sidelines were considered as secondary.

The storage and sideline functions were charged with those portions of an expense that could be directly attributed to them. The remainder of an expense was charged to the primary function, which included any expense attributable to the merchandising and handling function plus any excess or idle inputs.

NEED FOR MODERNIZATION

Many elevators built several decades ago are not adapted to the grain handling and storage needs of their area today because of inadequate capacity and equipment. Such elevators whose service has deteriorated because of such inadequacies face increasingly greater competition from adjacent firms. These elevators can usually obtain significant benefits from a well-planned modernization program designed to lower unit costs and improve service.

The grain handling and storage needs of the area depend upon the amount of farm storage and competitive commercial storage available, and the extent to which farmers desire to store grain. Some farmers have taken advantage of the government loan program to store wheat and soybeans in country elevators. Such grain is normally protected by a warehouse receipt. Other farmers do not deliver grain (usually corn) to the elevator until the Commodity Credit Corporation "take-over date." Grain thus received has gone through a period of farm storage and has made up a large portion of the stored stocks of country elevators.

Increased grain production has naturally resulted in greater amounts of grain available for sale by farmers. Since farm storage space has not increased as much as production, country grain elevators have felt the impact of these changes. Trade areas have expanded as transportation methods and roads have improved. These conditions, along with the government loan program, have increased the need for faster and more efficient receiving equipment, greater capacity to store grain temporarily until box cars are available, more capacity for permanent storage, and more efficient elevator design for greater flexibility and handling efficiency.

PROBLEMS IN CHOOSING A NEW FACILITY

Since each individual situation constitutes a problem in itself, the basic assumptions made by the authors in arriving at estimates should be reviewed carefully before arriving at a conclusion for a specific situation. The estimates are presented in detail so that a given item may be adjusted for a particular situation.

Immediate Questions to be Considered in a Local Situation

One group of questions relates to the kind of facilities now available. What is the size and condition of present facilities? How easily may equipment be replaced? What is the status of competing facilities?

A second group of questions relates to the kind of facilities that will be needed--both for handling or merchandising grain, and for storage of grain. How will potential volume be affected by changes in the size of the trade area and in the density of grain sales by farmers? What changes can be anticipated in acreage of different crops, in yields, and in quantities of grain used on the farm? How much of the increased production can the country elevator expect to store as compared to the farmer, the processor, and the terminal elevator? The answers to these questions are neither fixed nor certain; they will be affected in part by the services and facilities provided by a given firm and by his competitors.

Selecting the Proper Facility

The different examples in this report are recognition that many alternatives are open to the person who contemplates expanding his grain elevator facilities. Some facilities are more adaptable to one type of operation than another. The operator must estimate realistically the quantities of grain he can handle and store with the different types and sizes of facilities. The problem is to match the job that will need to be done with the type of facility best adapted to doing this job.

It should also be recognized that the type of facility provided has an influence on the job that will be done. Some firms that provide new facilities attract new business because the service they can render is improved.

GRAIN RECEIPTS AND STORAGE

In the Corn Belt, a country elevator will usually receive from two to four different grains; this fact has an important bearing upon the size and type of elevator needed. Such seasonality affects operating policies and costs related to handling and storage.

Storage utilization is hampered in the Corn Belt because: (1) Different grains are stored for different and overlapping periods, and (2) more space is often needed to handle the same amount of the several kinds of grains compared to a single grain. By having an adequate number of bins it is possible to obtain a higher utilization of storage capacity, even though it increases the initial cost of the elevator.

Turnover of grain in country elevators is usually greater in an area where several grains are marketed because the greater number of harvests spread the volume over a longer period. Also, in the Corn Belt, farmers store much grain on their farms, then deliver to country elevators throughout the year.

Seasonal distribution of receipts influence labor requirements and costs. In addition to seasonal labor it is normally necessary to maintain permanent employees to handle the several harvests. In order to more fully utilize such labor most elevators have a sideline operation.

DESCRIPTION OF ELEVATOR MODELS

The elevator models of modern design were developed from previous studies of Illinois elevators, information received from contracting engineers, and case studies of actual elevators. The costs of new buildings and equipment for the several models were representative of costs existing in Illinois in 1956. Local labor used in construction was assumed to be non-union. Labor cost for construction located near larger cities may be sharply higher.

Each model had a constant sideline volume of $100,000 consisting of a feed grinding and mixing operation and sales of feed, seed, fertilizer, and building supplies. Most elevators provide these products and services. The building assumed for warehousing the sidelines, including the grinding and mixing operations, was 40 by 155 feet. The cost of such a building was estimated at $30,000.

In all models, except the new 30,000-bushel model, an old 30,000-bushel wood cribbed ironclad elevator was operated in conjunction with a new elevator facility. The new facility was either a complete new concrete elevator, concrete tanks, or metal flat storage. The concrete tank models used the legs of the old 30,000-bushel elevator and conveyor augers to fill and empty the tanks. The two-metal flat-storage structures were assumed to

be a considerable distance from the old elevators so that it was necessary to use a portable conveyor to fill and empty these structures.

A summary of the models used is as follows:

Model

Old 30,000-bu. wood elevator
New 30,000-bu. concrete elevator
Old 30,000-bu. plus two new 20,000-bu. concrete tanks
Old 30,000-bu. plus four new 25,000-bu. concrete tanks
Old 30,000-bu. plus new 60,000-bu. concrete elevator
Old 30,000-bu. plus new 100,000-bu. concrete elevator
Old 30,000-bu. plus two new 55,000-bu. metal flat storage structures
Old 30,000-bu. plus new 200,000-bu.concrete elevator
Old 30,000-bu. plus new 400,000-bu. concrete elevator

Models used in this study were standardized to make costs comparable. However, when building new facilities for a specific location it may be advisable to deviate somewhat from facility items shown for the models. For instance, only one leg may be desired in the new house with provision for adding a new leg later if needed. Some elevator businesses may want two driveways for unloading trucks. Others may want to add cob burners. In areas where seed cleaning is important there may be a need for more and smaller bins accompanied by more elaborate cleaning equipment. In building new facilities, it is advisable to make provisions for future expansion or addition so as to avoid costly alterations.

Old Wood Elevator

The old 30,000-bushel elevator, used in the various models with new elevators, was a wood-cribbed ironclad elevator of the type built 25 to 30 years ago. In recent years much of the equipment was improved. It had two legs capable of elevating 3,000 bushels an hour, a 10-bushel automatic scale, two dump pits with steel grates, a 3-hp overhead trucklift, a corn sheller, and a cleaner.

Concrete Elevators

The new concrete elevators chosen for model elevators were of latest design, representing a high level of efficiency for the type specified. All concrete elevator models of 60,000 bushels and above had gravity flow to the driveway in the center. All contained equipment designed to handle grain rapidly and efficiently. All models had two legs whose elevating rate varied from 3,500 to 6,000 bushels an hour depending upon the elevator size (table 1). Standard equipment for all concrete models included an automatic scale, overhead truck lift, manlift, two grain dump pits, and other specified items shown.

The 30,000-bushel concrete elevator model was a single silo-type structure containing 14 bins, which provide flexibility needed in handling several kinds or grades of grain (figure 1). The 100,000-bushel elevator model had 17 bins of various sizes among the four main silos and accompanying interstices (figure 2). The 200,000-bushel elevator model also had 17 bins among its six silos and interstices (figure 3). The 60,000-bushel elevator model is not shown. However, its design was similar to the 100,000-bushel elevator. The 400,000-bushel elevator model (not shown) was of a design similar to the 200,000-bushel model with an addition of 200,000 bushels in concrete storage silos with a tripper, belts, and gallery.

Table 1.--Standard equipment for concrete elevator models

Item	Capacity of model elevator (bushels) :				
	30,000	60,000	100,000	200,000	400,000
Number of legs	2	2	2	2	2
Rate of elevation per leg	3,500	5,000	5,000	6,000	6,000
Size of leg motor (hp.)	15	25	25	40	40
Size of automatic scale (bu.)	10	15	15	25	25
Size of motor for overhead trucklift (hp.)	5	5	7½	7½	7½
Size of motor manlift (hp.)	3	3	3	3	3

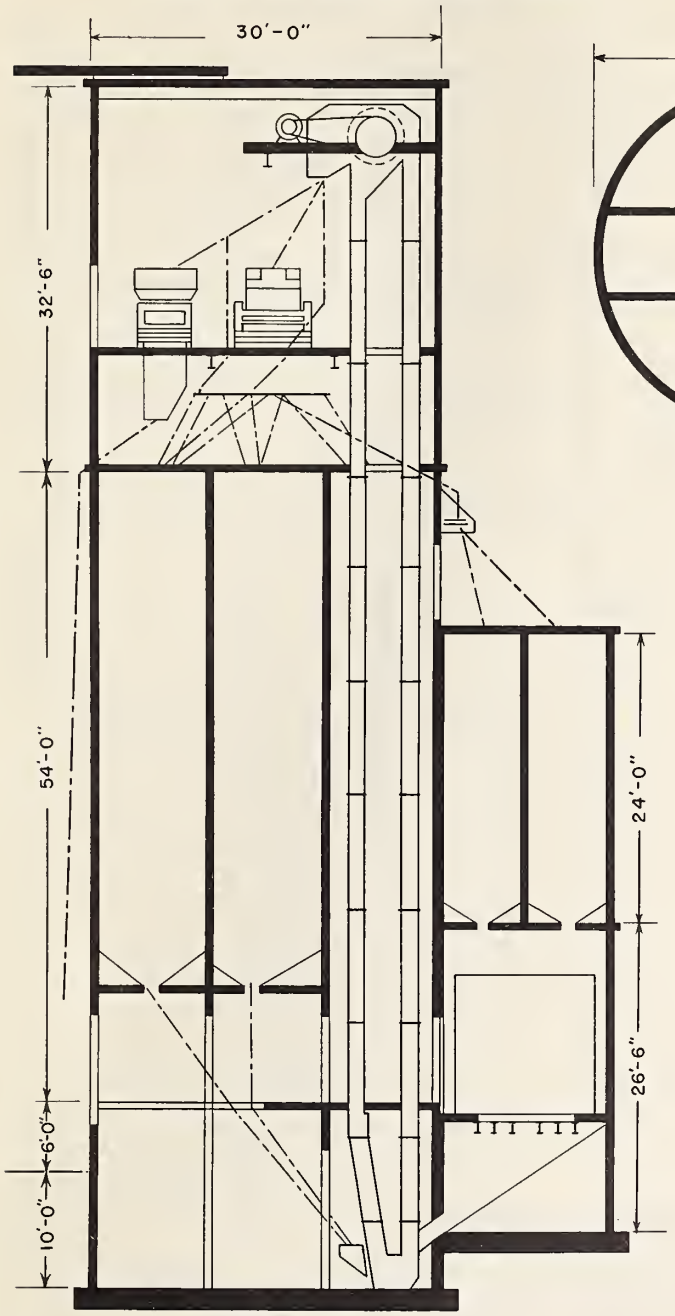
Standard equipment for all models:

All steel leg casing and spouting
All overhead bin valves with R & P
Two steel curtain driveway doors
Two dump pits with grates
All steel 3070 doors
Loading out spout well casing

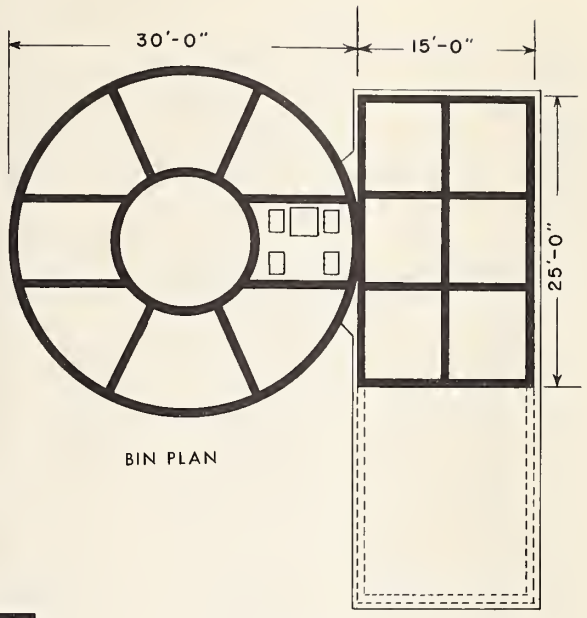
The corn sheller was located in an old 30,000-bushel wooden elevator in all models except for the new concrete 30,000-bushel elevator model which had a corn sheller with a cleaning attachment. The other concrete elevators did not have a sheller or cleaner. However, in many cases management may desire to add them.

The cost of constructing concrete models varied from $1.96 a bushel for the 30,000-bushel model to 61 cents for the 400,000-bushel model (table 2). Equipment costs for concrete elevators up to 200,000-bushel capacity tend to be somewhat fixed regardless of capacity, thus causing the equipment cost per bushel to decline sharply for larger elevators.

Figure 1. Type of New Elevator Design and Equipment Installation Used in the 30,000 Bushel Model



SECTION



BIN PLAN

CAPACITY

1 Bin	4,500	Bu.
2 Bins	4,200	Bu. Ea.
4 Bins	2,950	Bu. Ea.
1 Bin	2,250	Bu.
6 Bins	1,000	Bu.
Total	30,950	Bu.

STANDARD EQUIPMENT

All steel leg casing and spouting.

All over head bin valves with R & P.

Two steel curtain driveway doors.

Two dump pits with grates.

All steel 3070 doors.

L.O.S. well casing.

10 Bu. automatic scale.

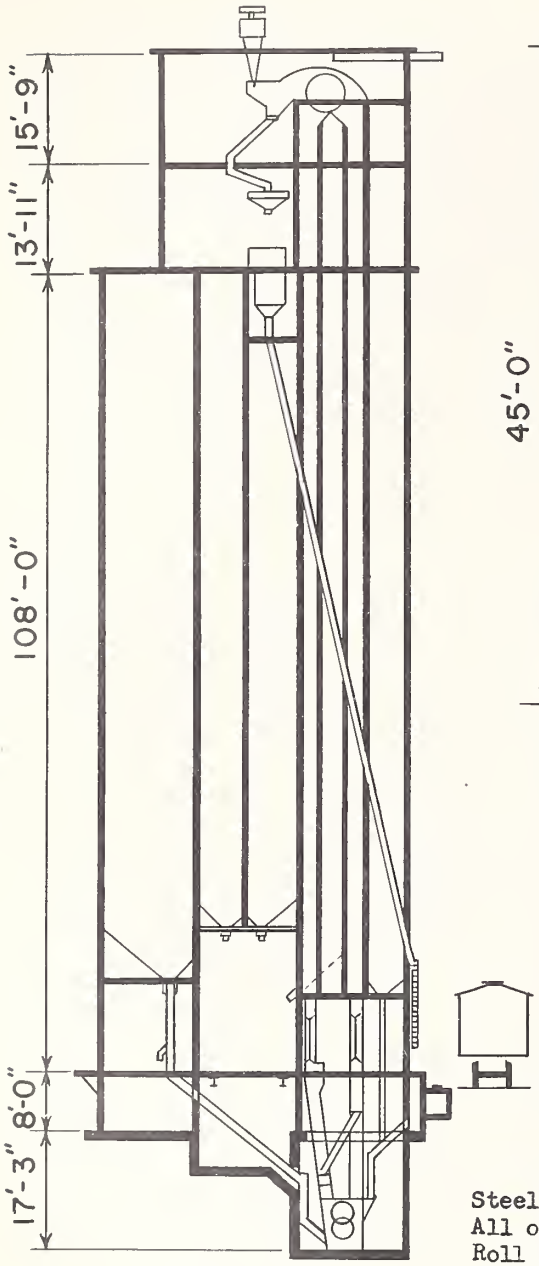
2--3,500 Bu. per hour elevating legs.

5 H.P. overhead trucklift.

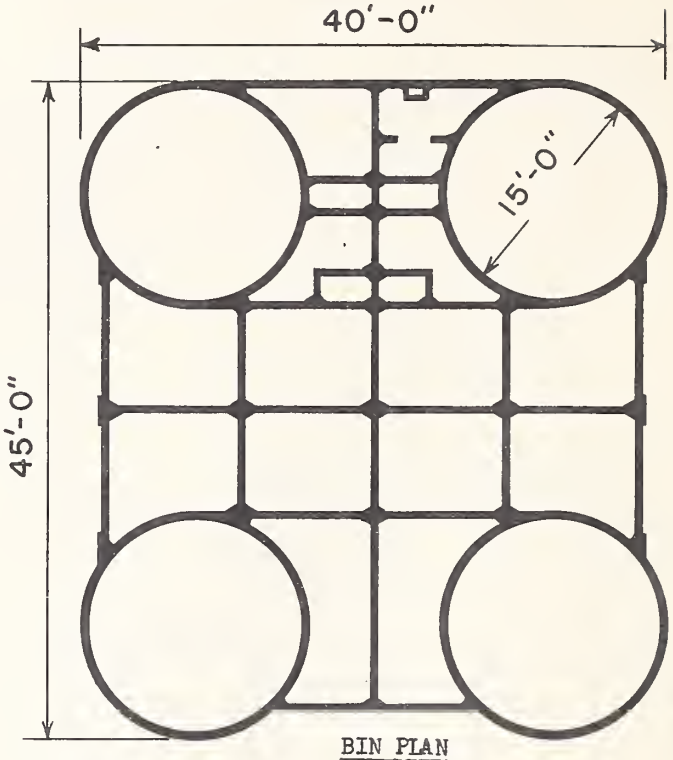
3 H.P. manlift.

Figure 2 . TYPE OF NEW ELEVATOR DESIGN AND EQUIPMENT INSTALLATION

USED IN THE 100,000 BUSHEL MODEL



SECTION



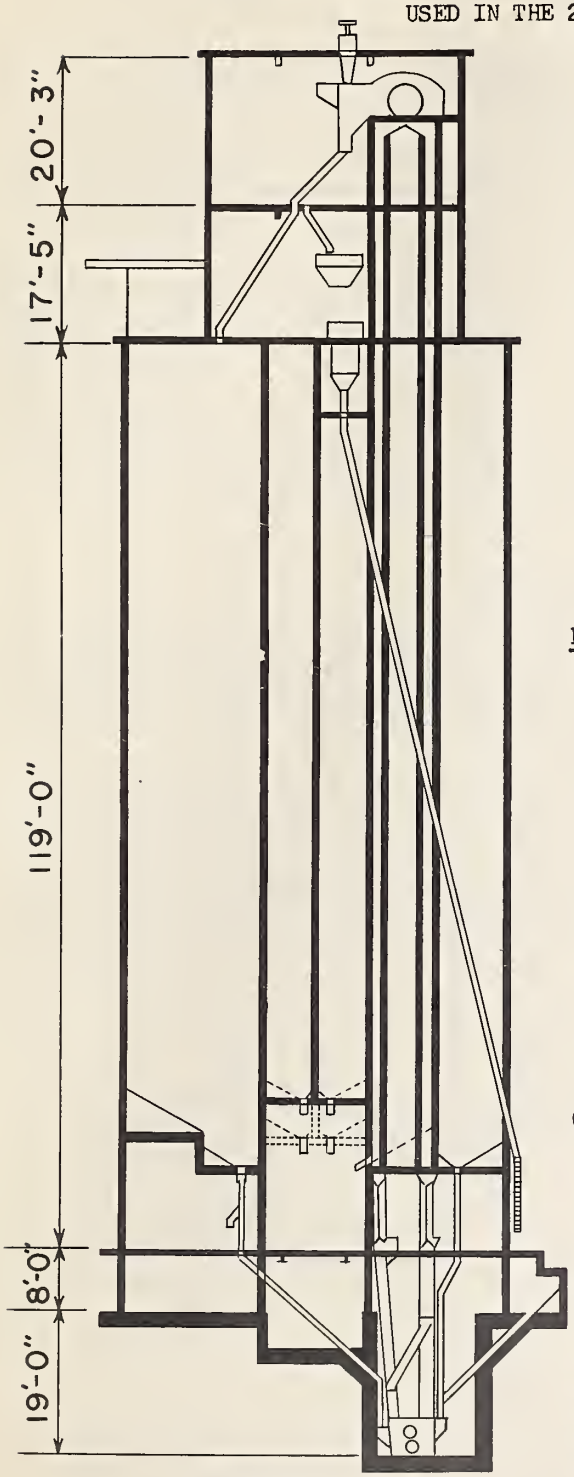
BIN PLAN

No. of Bins	Capacity
2	30,536
1	2,033
2	2,864
2	6,834
1	3,446
3	11,625
2	7,344
1	13,911
2	7,502
1	14,052
Grand Total	100,147

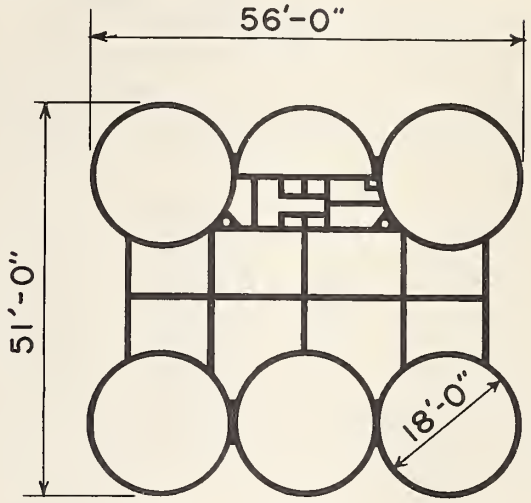
STANDARD EQUIPMENT

Steel spouting and leg casing
All over head bin valves with R. & P.
Roll up type steel curtain driveway doors
Two dump pits with grates
Overhead electric truck lift - 7½ h.p.
Steel windows and 3' x 7' steel doors
Loading out spout of steel with flex
Electric manlift - 3 h.p.
Automatic shipping scale, 15 bu.
Two 5,000 bu. per hour legs

Figure 3. TYPE OF NEW ELEVATOR DESIGN AND EQUIPMENT INSTALLATION USED IN THE 200,000 BUSHEL MODEL



SECTION



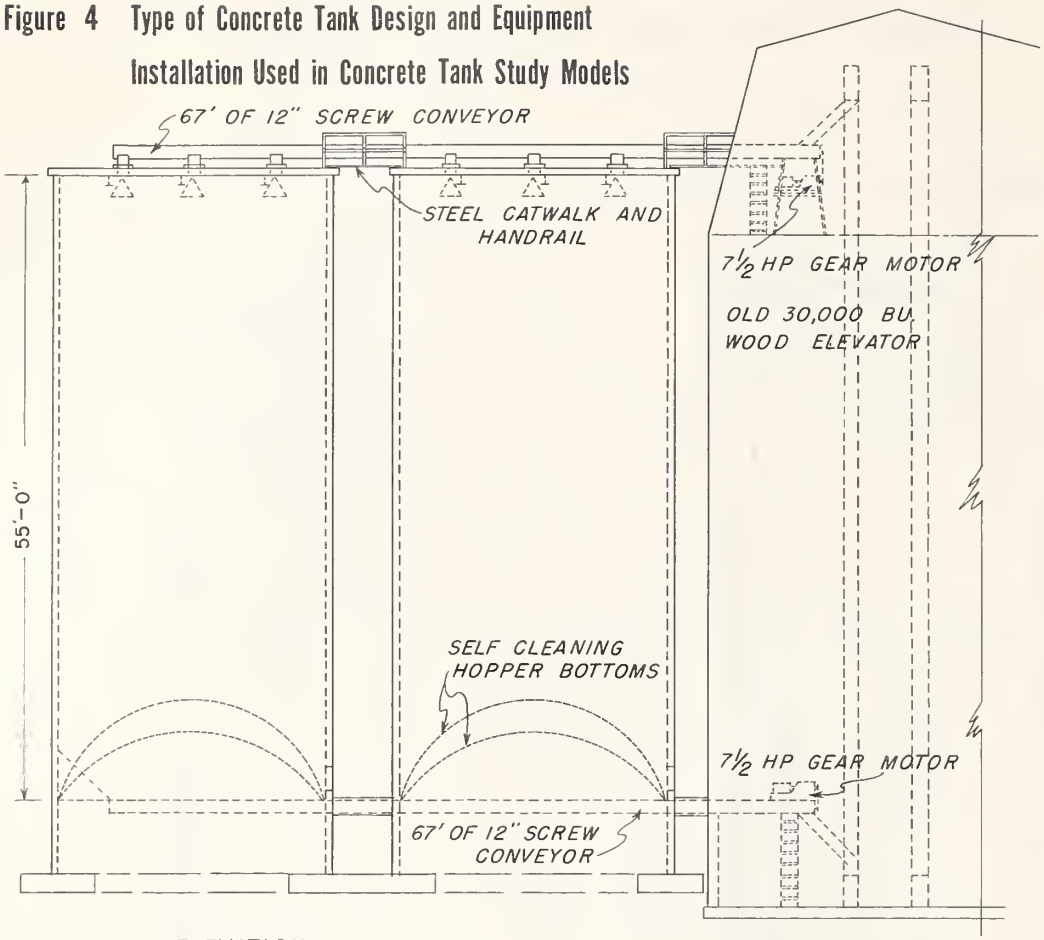
BIN PLAN

No. of Bins	Capacity
2	51,681
1	11,004
1	1,986
1	3,917
1	2,486
1	5,814
1	9,513
1	10,072
1	5,508
1	5,934
1	8,359
1	7,920
1	5,622
2	48,731
1	22,026
Grand Total	200,573

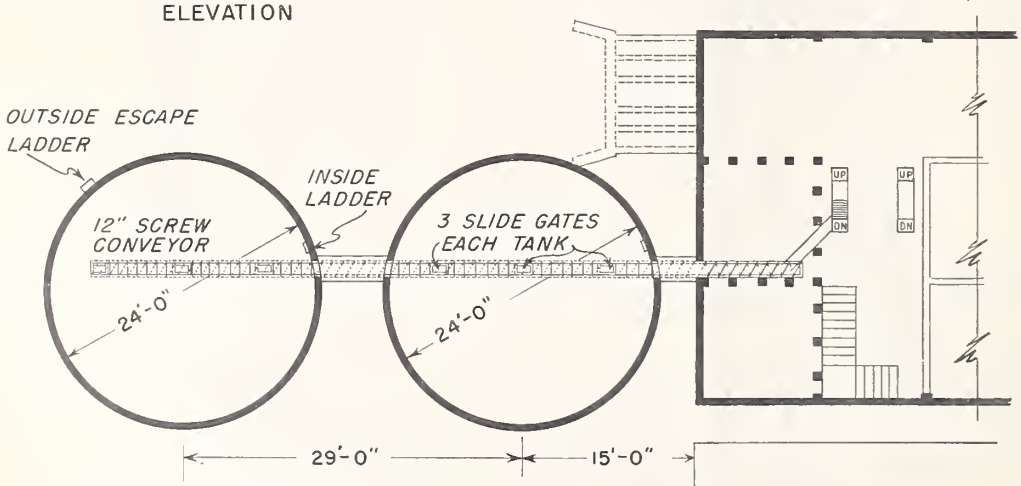
STANDARD EQUIPMENT

Steel spouting and leg casing
All overhead bin valves with R. & P.
Roll up type steel curtain driveway doors
Two dump pits with grates
Overhead electric truck lift - 7½ h.p.
Steel windows and 3' x 7' steel doors
Loading out spout of steel with flex
Electric manlift - 3 h.p.
Automatic shipping scale, 25 bu.
Two 6,000 bu. per hour legs

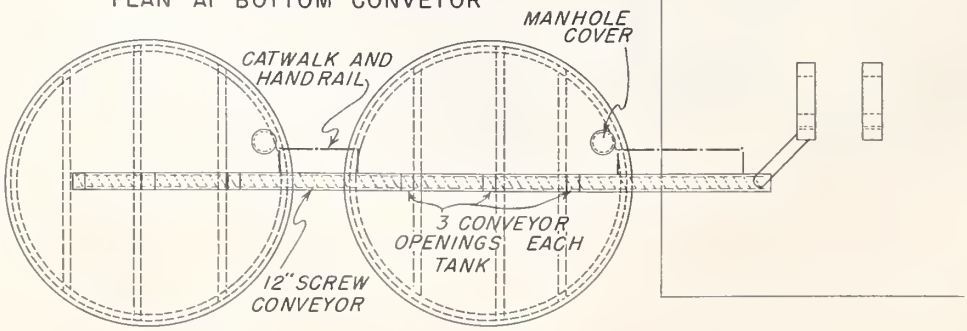
Figure 4 Type of Concrete Tank Design and Equipment Installation Used in Concrete Tank Study Models



ELEVATION



PLAN AT BOTTOM CONVEYOR



PLAN AT TOP CONVEYOR

Table 2.--Facility costs and cost per bushel of capacity, new elevator facilities used in models

New elevator facility	Total facility cost	Equipment cost	Building cost	Cost per bu. of capacity: Total	Equip.	Bldg.
(1,000 bu.)	(dollars)					
30-bu. concrete	$ 59,000	$ 1/22,000	$ 37,000	$ 1.96	$ .73	$ 1.23
Two 20-bu. concrete tanks	29,600	8,400	21,200	.74	.21	.53
Four 25-bu. concrete tanks	60,000	10,000	50,000	.60	.10	.50
60-bu. concrete	79,000	20,000	59,000	1.31	.34	.98
100-bu. concrete	95,000	22,000	73,000	.95	.22	.73
Two 55-bu. flat	37,300	5,300	32,000	.34	.05	.29
200-bu. concrete	138,000	24,000	114,000	.69	.12	.57
400-bu. concrete	242,000	36,000	206,000	.61	.09	.52

1/ Includes $4,000 for corn sheller with cleaner attachment (equal to 13.3 cents a bushel).

Concrete Tanks 1/

The concrete tank models represented the type being erected in Illinois (figure 4). Such tanks are commonly built next to an existing wood elevator. Grain is handled through these tanks by using the leg of the old elevator and screw conveyors to carry the grain from the head to tanks and from tanks to boot.

The concrete tanks used in the models had 24-ft. diameters. Leading and unloading conveyors were of the screw type, and tanks had hoppered bottoms (see below). Hoppered bottoms are used for convenience and to save labor, but are slightly more costly per bushel of capacity. Where the headhouse is high enough, gravity may be used instead of conveyors to fill the tanks, thereby reducing equipment cost. In other cases the headhouse may have to be raised in order to use conveyors.

Standard characteristics of the concrete tank models were as follows:

(A) Two 20,000-bu. concrete tank model:

Hoppered floors
Top loading conveyors - 12-in. screw in steel box 67 ft. long
Lower unloading conveyors - 12-in. screw in steel wood box 67 ft. long
Two 7½ hp. gear motors with drives
One steel stairway and two metal catwalks

(B) Four 25,000-bu. concrete tank model:

Hoppered floors
Top loading conveyors - 12-in. screw in steel box 127 ft. long
Lower unloading conveyors - 12-in. screw in steel lined wood box 127 ft. long
Two 15 hp. gear motors with drives
One steel stairway and four metal catwalks

1/ Complete information on metal tanks was not collected. However, costs associated with metal tanks are generally considered to be comparable to those of concrete tanks.

Concrete tank facilities are relatively less costly to build than complete concrete elevators because the headhouse of the old wooden elevator is used to receive, elevate, and load out grain (table 2). The performance of the two types is somewhat different. Concrete tanks similar to the models used generally handle grain slower and are less flexible mainly because they have fewer bins. In areas where several grains are handled, it is desirable to have enough bins to permit greater flexibility in handling, storing, and mixing.

When storing grain in concrete tanks, empty space must be available for turning the grain in the largest storage tank. When the old adjoining elevator is used for merchandising and handling operations there is frequently not enough space to turn the largest tank, which means that another tank or a portion thereof must be available. This requirement reduces the storage utilization of tank storage. Consideration should be given to constructing smaller concrete or metal tanks of around 12,000 to 15,000 bushels. These smaller tanks will give greater flexibility in merchandising and handling. However, building costs per bushel are likely to be higher.

Flat Storage

Flat storage model comprised the old 30,000-bushel elevator and two 55,000-bushel steel structures, which were either of the Quonset or rectangular type measuring 40 by 120 feet. The primary function of this model was for long-term storage. Receiving and loading out was considered a merchandising and handling function. The largest portions of expenses were charged to the storage function because of the normal low turnover. Aeration and other care of the grain was included in the cost of storage.

Construction cost for each flat storage building model was $16,000, or 29 cents per bushel of storage. Total cost of new building and equipment was 34 cents per bushel of capacity (table 2).

Equipment in the two flat storage structures included aeration equipment valued at $2,000 and temperature detection systems valued at $1,300. This equipment was used solely for the storage function. In order to fill and empty the buildings a portable conveyor valued at $2,000 was included. Total equipment cost for the two buildings totaled $5,300 or 5 cents per bushel of storage. By having temperature detecting equipment and aerating equipment, it was assumed that turning the grain was unnecessary. If turning should become necessary, about 18,000 bushels could be moved temporarily from one end of the building to the old elevator. The remaining grain could be revolved by the use of a portable conveyor. Such a turning operation would have a labor cost of approximately six-tenths of a cent a bushel in addition to other costs such as gasoline, depreciation, and repairs on the conveyor. In order to avoid turning, the grain should be dry when stored and fumigated to prevent insect infestation.

ASPECTS OF SIDELINE OPERATIONS

The costs allocated to the sideline function totaled the same at all volume levels for a given elevator model. By holding the sideline sales volume constant at $100,000, the sideline expenses made up a variable proportion of total

expenses at the various volume levels. Thus, sideline expenses became relatively less important as grain volume increased. In actual practice, of course, sideline sales volume may not remain constant as the volume of grain increases.

Sidelines permit absorption of idle and excess physical inputs and put them to profitable use. This was especially true for the smaller elevator models and at low volumes. At higher grain volumes where sidelines expense become a smaller proportion of total expense, there was less opportunity to absorb excess inputs occasioned by the nature of the business.

Sidelines are important to the elevator because in rendering such added services to farmers they also provide an opportunity to gain additional grain volume from the same farmers who purchase sidelines. Good management will take advantage of the relationship between grain and sidelines by rendering good efficient service in its sideline operations.

GENERAL ASSUMPTIONS MADE IN BUDGETING

Expense items for each elevator model were budgeted for three functions at various volumes handled and stored. Those functions were merchandising and handling, storage, and sidelines.

In making assumptions with respect to the various factors influencing the budgeting methods, the most important overall consideration was the relationship between the models. It was more important to have budgeted expenses in the proper relation between models than it was to have expenses at the right level since the study sought to compare relative costs for different sizes and types of elevators.

All elevator models were assumed to be in the same economic environment in a relatively prosperous area of the Corn Belt.

Other important general assumptions were made with respect to elevator facilities, quality of inputs, capacity relationships, base volumes, and kinds of grain stored. Specific assumptions made in budgeting individual expense items are discussed later for each expense.

Elevator Facilities

The new elevators used in the models were representative of the newer types and sizes being built in the Corn Belt. All facilities of the same type were assumed to be equal in quality of material, equipment, and design. They had comparable abilities, for their size and type, to handle and store grain efficiently.

All elevator models had facilities to perform the three functions--merchandising and handling, storage, and sidelines. The sideline facilities were the same for all elevator models.

Quality of Inputs

The quality of all operating inputs, such as labor, repairs, power and insurance, for a given type and size of elevator model were assumed to be representative of the better managed elevators.

There was some variation assumed in the quality of the inputs and dollar rates per unit of input between the different elevator models. This was dictated by the nature and requirements of the facilities. For example, managers of the larger elevators usually receive higher salaries. A detailed description of such variations is made later in the budgeting of individual expense items.

Capacity Relationships

The capacity of an elevator may be expressed in two different ways: (1) Rated storage capacity and, (2) maximum storage capacity. Rated storage capacity is all the space that can hold grain. It is used by State and Federal agencies in figuring the warehouse license fee.

Maximum storage capacity is that storage level beyond which it is not normally practical to add grain to storage because of the need for turning space or other working space. For the elevator models, it varied from 63 to 88 percent of the rated capacity of the new facility plus 5,000 bushels in the old 30,000-bushel elevator (table 3).

Base Volume Handled or Stored

Base volume was the grain volume handled or stored for an elevator model which was representative for such type and size of elevator in Central Illinois (table 3). The purpose of establishing the base volumes was twofold: (1) To provide a comparable level at which costs can be compared between models, and (2) to provide a base from which to budget individual expense items at other volumes for the same elevator.

The base storage volume was compared with the maximum storage capacity for each elevator model to obtain measures of storage utilization varying from 45 to 67 percent (table 3). The base handling volume was compared with rated capacity for each elevator model to determine grain turnovers ranging from 6.7 times for the 30,000-bushel elevators to 2.3 times for the 400,000-bushel elevator model.

For other areas of the Corn Belt, the base volumes might be different because of different conditions such as those relating to the kind and relative volumes of grains marketed, farm storage and usage, competitive facilities, and space needed for merchandising and handling.

Table 3.—Capacity - volume relationship for elevator models

	(1) Rated capacity	(2) Maximum storage capacity	(3) Base storage volume	(4) (3) ÷ (2) Storage Utilization	(5) Base handling volume 1/	(6) (5) ÷ (1) Turnover at base volume
		(1,000 bu.)		(percent)	(1,000 bu.)	(number)
Old or new 30,000-bu. elevator	30	5	-	-	200	6.7
Old 30,000-bu. + two 20,000-bu. concrete tanks	70	30	15	50	300	4.3
Old 30,000-bu. + four 25,000-bu. concrete tanks	130	85	45	53	400	3.1
Old 30,000-bu. + 60,000-bu. concrete	90	55	25	45	500	5.6
Old 30,000-bu. + 100,000-bu. concrete	130	90	45	50	600	4.6
Old 30,000-bu. + two 55,000-bu. flat	140	90	60	67	300	2.1
Old 30,000-bu. + 200,000-bu. concrete	230	180	90	50	800	3.5
Old 30,000-bu. + 400,000-bu. concrete	430	360	180	50	1,000	2.3

1/ Based on audit information and schedules of the North-Central Regional Marketing Committee (NCM-10) showing capacity for Illinois elevators, 1954-5.

Kinds of Grain Stored and Handled

The storage level reflects annual utilization of storage space as influenced by seasonality of receipts, length of storage, and kind of grain. The distribution of storage utilization assumed for concrete elevators by kind of grain was 38 percent corn, 5 percent oats, 9 percent wheat and 48 percent soybeans. The utilization of tank and flat storage was less dependent upon the seasonality of storage receipts since they tended to limit their storage to one or two kinds of grain.

The proportion of different grains handled by an elevator varies between years and areas. The elevator models were assumed to be located in an area where the average proportion of grain handled was 59 percent corn, 6 percent oats, 13 percent wheat, and 22 percent soybeans. The greatest seasonal peaks in handling grain occurred in June, July, September, and October.

BUDGETING FIXED EXPENSES

Fixed expenses were depreciation, insurance, interest on long-term capital 2/, property taxes, bonds and licenses, and rail lease. Expenses were budgeted and allocated separately for each expense item at base volumes handled and stored (appendix table 1). Fixed expenses comprised from 36 to 46 percent of total expenses for the various models (table 13). All of these expenses except insurance and taxes on grain inventory would be incurred regardless of volume handled or stored. Management can generally do nothing to reduce total fixed expense, but fixed expense per bushel handled or stored can be rapidly reduced by volume increases.

Depreciation

Depreciation expense comprised the major fixed expense. It was a function of the elevator cost and the rate of depreciation. Elevator costs for the new facilities in the models were obtained from construction engineers and a straight-line rate of depreciation used. All concrete structures were depreciated at an annual rate of 3 percent and the flat storage model at 5 percent. Elevator equipment, scales, office equipment, and feed-mill equipment carried a 10 percent depreciation rate.

Depreciation expense was first calculated separately for buildings and equipment because of different depreciation rates. Likewise, the allocation of depreciation expense was made separately. For a given model, depreciation was allocated between the two grain functions in different proportions for buildings and equipment (table 4). The resulting allocation was fixed for all volumes handled and stored. The percentage allocations were applied to total depreciation expense to obtain the charge to each function (table 5).

2/ Interest on long-term capital differed from interest expense commonly found in operating expense statements since it included the estimated interest expense of equity capital.

Table 4. Percentage allocation of fixed expenses to each function and depreciation valuations, by elevator model

Facility or equipment	Depreciation Valuation	Allocation to functions		
		Sideline	Merchandising and handling	Storage
	(dollars)		(percent)	
Elevator Buildings				
Old 30,000-bu. wood	$ None	-	-	-
New 30,000-bu. concrete	37,000	-	100	-
New 30,000-bu. + two 20,000-bu. concrete tanks	21,200	-	50	50
New 30,000-bu. + four 25,000-bu. concrete tanks	50,000	-	30	70
New 30,000-bu. + 60,000-bu. concrete	59,000	-	60	40
New 30,000-bu. + 100,000-bu. concrete	73,000	-	50	50
New 30,000-bu. + two 55,000-bu. flat steel	32,000	-	-	100
New 30,000-bu. + 200,000-bu. concrete	114,000	-	35	65
New 30,000-bu. + 400,000-bu. concrete	206,000	-	30	70
Elevator Equipment				
Old 30,000-bu. wood	13,000	-	100	-
New 30,000-bu. concrete	22,000 1/	-	100	-
New 30,000-bu. + two 20,000-bu. concrete tanks	8,400	-	60	40
New 30,000-bu. + four 25,000-bu. concrete tanks	10,000	-	55	45
New 30,000-bu. + 60,000-bu. concrete	20,000	-	85	15
New 30,000-bu. + 100,000-bu. concrete	22,000	-	80	20
New 30,000-bu. + two 55,000-bu. flat steel	5,300	-	40	60
New 30,000-bu. + 200,000-bu. concrete	24,000	-	75	25
New 30,000-bu. + 400,000-bu. concrete	36,000	-	70	30
Office and Scales				
Building	4,200	15	85	-
Scales	6,900	5	95	-
Other equipment	500	-	100	-
	11,600	-	-	-
Sidelines				
Warehouse	30,000	100	-	-
Feed mill equipment	5,500	100	-	-
	35,500	-	-	-

1/ Includes corn sheller valued at $4,000.

Table 5. Calculation and allocation of annual depreciation expense for elevator study models

Facility or equipment	Valuation	Rate	Depreciation	Allocation by function		
				Sideline	Merchandising and handling	Storage
(1,000 bu.)		(percent)				
Elevator building						
Old 30 wood	$ none	-	$ -	$ -	$ -	$ -
New 30 concrete	37,000	3	1,110	-	1,110	-
New two 20 concrete tanks	21,200	3	636	-	318	318
New four 25 concrete tanks	50,000	3	1,500	-	450	1,050
New 60 concrete	59,000	3	1,770	-	1,062	708
New 100 concrete	73,000	3	2,190	-	1,095	1,095
New two 55 flat steel	32,000	3	1,600	-	-	1,600
New 200 concrete	114,000	3	3,420	-	1,197	2,223
New 400 concrete	206,000	3	6,180	-	1,854	4,326
Elevator equipment						
Old 30 wood	13,000	10	1,300	-	1,300	-
New 30 concrete	22,000 1/	10	2,200	-	2,200	-
New two 20 concrete tanks	8,400	10	840	-	504	336
New four 25 concrete tanks	10,000	10	1,000	-	550	450
New 60 concrete	20,000	10	2,000	-	1,700	300
New 100 concrete	22,000	10	2,200	-	1,760	440
New two 55 flat steel	5,300	10	530	-	265	265
New 200 concrete	24,000	10	2,400	-	1,800	600
New 400 concrete	36,000	10	3,600	-	2,520	1,080
Office and scales						
Building	4,200	5	210	32	178	-
Scales	6,900	10	690	34	656	-
Other equipment 2/	500	10	50	-	50	-
	11,600		950	66	884	-
Sidelines						
Warehouse	30,000	5	1,500	1,500	-	-
Feed mill equipment	5,500	10	550	550	-	-
	35,500		2,050	2,050	-	-

1/ Includes $4,000 corn sheller with cleaner attachment.

2/ Moisture tester, office furniture, misc. equipment — some of which had been fully depreciated.

It was assumed that no grain was stored in either the new or the old 30,000-bushel elevators; thus, all depreciation was allocated to the merchandising and handling function for these models. The old 30,000-bushel elevator building was completely depreciated; however, the equipment was valued at $13,000.

Allocation of depreciation expense was based upon the intended use of the buildings and equipment. The merchandising and handling function was considered the primary function. The elevator equipment was installed primarily to handle grain; thus a higher percent of total equipment depreciation expense was charged to the merchandising and handling function. The charge to the storage function was based upon the direct use to be made of the equipment for turning grain while in storage.

It was assumed that all grain stored in concrete elevators and tanks was turned or elevated three times, and that grain handled averaged two elevators. In a turning operation grain is usually elevated considerably slower than when receiving or loading out. All the above factors were considered in arriving at an allocation of equipment depreciation expense between the two grain functions.

All the depreciation expense for the warehouse and feed-mill equipment was allocated to the sideline function. Also, a small portion of depreciation on the office building and scales was allocated to sidelines.

Depreciation expense for the elevator buildings was allocated to the two grain functions according to the use and purpose of the capacity. Important considerations were the bushels of space utilized, length of space occupancy, and amount of required turning space. An even more basic consideration was the purpose of the storage capacity which may be divided between basic and supplemental. Basic capacity is that elevator capacity which would be built for the primary use of handling and merchandising grain for a quick turnover and assuming that no grain was intended to be stored or held for more than 30 days. Supplementary capacity is that capacity in addition to the basic capacity and used to store grain over 30 days either for future shipment or local use.

Insurance

Fixed insurance expenses included fire and extended coverage insurance on buildings and equipment plus crime and liability insurance. All models had the same type of insurance coverage. The building and equipment insurance coverage was assumed to be 80 percent of the cost of new facilities as shown in table 6. The old 30,000-bushel elevator was covered for 80 percent of an estimated insurable value of $14,000.

Insurance rates for the different types of elevators vary sharply because of the difference in risk. One of the important disadvantages of wood elevators is the high insurance rate, which in this study was set at a conservative rate of $1.10 per $100 coverage. Rates for concrete tanks were somewhat lower but were higher than for a concrete elevator because they were located

next to a wood elevator. Rates for concrete elevator models were set at 13 cents per $100, which assumes they have met rigid requirements relating to fire safety. Management planning to build should consult a reliable insurance company to see that fire safety features are incorporated in the building plans so as to be assured of minimum rates.

A comprehensive crime policy was a fixed insurance cost carried by all models in the same amount. It covered a $25,000 employee bond, $1,000 burglary on merchandise, $1,000 burglary on securities (inside), $1,000 burglary on securities (outside), and $25,000 forgery. A public liability policy was another fixed insurance cost. Coverage was $25,000/$50,000 for bodily injury and $10,000 for property damage.

Allocation of fire and extended coverage insurance to the three functions was performed by using the percentage allocations for fixed expenses shown in table 4.

In allocating comprehensive crime and public liability premium costs, important considerations were payroll, size of sideline operations, and the fact that merchandising and handling was the primary function.

Table 6.—Fire and extended coverage insurance amounts, rates, and allocations for buildings and equipment of study models

Facility and model	Insurance coverage	Rate per $100	Allocation by functions: Sideline	Merchandising & handling	Storage	Total
Elevator building and equipment						
Old 30,000-bu. wood	$21,600	$1.10	-	$238	$ -	$238
New 30,000-bu. concrete	47,200	.28 1/	-	132	-	132
Two new 20,000-bu. concrete tanks	34,080	.30	-	40	31	71
Four new 25,000-bu. concrete tanks	58,400	.30	-	49	95	144
New 60,000-bu. concrete	73,600	.13	-	55	27	82
New 100,000-bu. concrete	86,400	.13	-	56	43	99
Two new 55,000-bu. flat storage	37,600	.22	-	4	65	60
New 200,000-bu. concrete	120,800	.13	-	68	76	144
New 400,000-bu. concrete	204,000	.13	-	91	161	252
Office, scales, and equipment	9,280	.67	5	57	-	62
Sidelines						
Warehouse and Feed-Mill Equipment	28,400	1.16	329	-	-	329

1/ This rate was higher than for the other new concrete models because of the increased risk resulting from the corn shelling operation. In the other models a corn sheller was located in the old 30,000-bushel elevator.

Personal Property Taxes

There was no uniformity among counties in the property tax rates and assessment values. Another complication arose from the wide variation between assessed valuation and net book values among country elevators. Also, some counties assessed elevator equipment as personal property instead of real property. In order to obtain uniformity between models it was assumed that all buildings and equipment, as well as inventory, were assessed at the same rate.

Using the case study elevators as a basis, it was assumed that the assessed value was 50 percent of the insurable value, that the taxable inventory on April 1 was at 5 percent of capacity, and that the tax rate was $2.50 per $100 of assessed valuation. The cost value of the new buildings and equipment and a market value of $2 a bushel of grain inventory were used to determine the insurable value of the model elevators. By applying the tax rate of $2.50, the annual property tax cost was estimated. Property taxes were allocated to the three functions according to the allocations for fixed expenses shown in table 4.

Bonds and Licenses

An elevator accepting grain for storage in Illinois must have a license. The new Illinois warehouse law requires an initial filing fee of $20 and charges for inspection at $15 each, but not more than $30 a year regardless of number of inspections. At the time of this study, presumably a license was valid indefinitely. 3/ Records of the case study elevators did not reveal any expenses for filing fee or inspections; consequently, no license cost was included in this study.

Most elevators obtain a bond as a prerequisite to licensing. A legal liability insurance policy may be substituted. This study assumed that a Federal bond was obtained to operate according to the provisions of the U. S. Warehouse Act. The rate for determining the bond amount was 6 percent of the commodity value. The rate used per bushel of capacity was 12.6 cents. The minimum bond permitted was $10,000 and the maximum bond $200,000.

The bond premium rate schedule was $5 per $1,000 of bonding up to $10,000; $2.50 per $1,000 for the next $15,000; and $1.25 per $1,000 for all above $25,000. All bond premium expense was charged to the storage function.

A corporation franchise tax of $10 levied by the State was a fixed expense carried by each model.

Interest on Long-Term Capital

Long-term capital generally consists of deferred liabilities and ownership capital. Such capital is required regularly as contrasted with seasonal capital needed only during harvests. Interest on seasonal capital is subsequently discussed as a variable expense, whereas interest on long-term capital

3/ Stanley W. Phillips. North Central States Grain Warehouse Regulations, N. C. Regional Publication No. 68, p. 9. Kansas State College of Agriculture, Exper. Station, Manhattan.

was considered here as a fixed expense.

This expense item is not entirely comparable to the interest expense commonly found in operating statements or audits. In actual practice, interest on deferred liabilities is usually shown in the operating expense statements. However, the cost of ownership capital may be shown as a stock dividend or, in the case of reserves and surplus, no interest cost will be shown.

The proportion of interest-incurring capital used generally varies considerably among actual elevators. Thus, in order to keep the models on a comparable basis, interest expense was calculated on all long-term capital.

Long-term capital is roughly equal to net assets (total assets less current liabilities). In order to facilitate the allocation of interest on long-term capital between functions, the net assets for each model were divided between fixed assets and other assets for each function (table 7). An interest rate of 4 percent was applied to the long-term capital required for each of the three functions of each model.

Railroad Lease

It was assumed that the model elevators were on land leased for a long term from a railroad. The annual cost of such a lease in this study varied with the size of plot leased. The larger elevator models were located on a larger land area. The annual rental varied from $20 for the 30,000-bushel model to $180 for the 400,000-bushel elevator.

All railroad lease expense was allocated to the two grain functions. A base charge of $20 was made to the grain merchandising and handling function for the land required for a 30,000-bushel elevator and the sideline operation. Any such expense above that base was prorated equally between the two grain functions.

BUDGETING VARIABLE EXPENSES

Variable expenses by their definition indicate they vary with changes in the volume of business. The degree of variation differs sharply among the so-called variable expense items. That is,some expenses called sticky expenses respond slowly to volume and size changes while others respond more proportionately to such changes. For this reason, each variable expense item was budgeted separately (appendix table 2). A summary of the ratios used in budgeting and allocating each variable expense item can be found in appendix table 3.

Personnel Expenses

Personnel expenses comprise salaries, wages, workmen's compensation insurance, and social security taxes. Such expenses comprised 34 to 43 percent of total expenses for the various models at base volumes (table 13). Thus, these expenses were extremely important from the standpoint of unit costs and the allocation of costs to the three functions.

Table 7.—Long-term capital used and interest expense by operating function

Elevator model	Long-term capital used by function								Interest expense of long-term capital by functions: 1/			
	Total		Sidelines		Merchandising and handling		Storage					
	Fixed assets	Other assets	Fixed assets	Other assets	Fixed assets	Other assets	Fixed assets	Other assets	Total	Sidelines	Grain merchandising & handling	Grain storage
(1,000 bu.)	(dollars)											
Old 30 wood	$60,100	$30,400	$36,475	$20,000	$23,625	$10,400	$ -	-	$3,620	$2,259	$1,361	$ -
New 30 concrete	106,100	30,400	36,475	20,000	69,625	10,400	-	-	5,460	2,259	3,201	-
Old 30 + two 20 concrete tanks	89,700	32,400	36,475	20,000	33,855	12,400	19,370	-	4,884	2,259	1,850	775
Old 30 + four 25 concrete tanks	120,100	36,800	36,475	20,000	38,065	16,800	45,560	-	6,276	2,259	2,195	1,822
Old 30 + 60 concrete	139,100	34,400	36,475	20,000	73,865	14,400	28,760	-	6,940	2,259	3,531	1,150
Old 30 + 100 concrete	155,100	37,200	36,475	20,000	74,915	17,200	43,710	-	7,692	2,259	3,685	1,748
Old 30 + two 55 flat steel	97,400	30,400	36,475	20,000	17,735	10,400	43,190	-	5,112	2,259	1,125	1,728
Old 30 + 200 concrete	198,100	44,400	36,475	20,000	78,065	24,400	83,560	-	9,700	2,259	4,099	3,342
Old 30 + 400 concrete	302,100	58,800	36,475	20,000	106,515	38,800	159,110	-	14,436	2,259	5,812	6,365

1/ A 4 percent rate of interest was used.

Personnel Requirements

The regular personnel requirements of the models varied from two to five persons depending upon the volume handled (table 8). It was assumed that all models had efficient employees. Certain employee responsibilities increase with the increase in grain volume and elevator capacity, however.

The manager carried all the duties of the bookkeeper until volume reached 300,000 bushels, at which time a part-time bookkeeper was hired. At 600,000-bushel volume, a full-time bookkeeper was hired. The elevator man also handled sidelines with help of the manager as long as volume stayed at 100,000 bushels. When it reached 150,000 bushels, he had help from an extra man hired for 4 months yearly. At 200,000 bushels an extra man was hired full time to handle the feed mill and supply warehouse. A second elevator man was hired when grain volume reached 1 million bushels. Extra labor was hired during harvest and for special jobs.

Table 8.--Employee requirements expressed in man-months at specified volumes handled 1/

Volume handled	Manager	Bookkeeper	First elevator man	Second elevator man	Feed mill and warehouse man	Extra labor	Total
(bushels)			(man-months)				
100,000	12	2/	12	-	3/	4	28
150,000	12	2/	12	-	4	5	33
200,000	12	2/	12	-	12	1	37
300,000	12	6	12	-	12	2	44
400,000	12	7	12	-	12	3	46
500,000	12	9	12	-	12	4	49
600,000	12	12	12	-	12	4	52
800,000	12	12	12	-	12	7	55
1,000,000	12	12	12	12	12	1	61
1,200,000	12	12	12	12	12	3	63

1/ In actual practice, the "jumps" in man-month requirements resulting from volume increases may occur at different volume levels than shown here.
2/ Manager keeps books.
3/ First elevator man and manager take care of feed mill and warehouse.

Budgeting Total Personnel Expenses

Total personnel expenses were developed from the case study elevators and from audit information on Illinois country elevators. This was done separately for each employee. Appendix table 4 shows the total annual salaries and wages of each employee for each elevator model at base volumes handled and stored. Differences in employee annual wages between models were directly related to the maximum storage capacity of the model. Such differences reflect increased employee responsibilities in both the storage and handling functions. For a given model, changes in employee annual wages were directly related to changes in volume handled.

The rates of change in employee annual wages were established for differences in maximum storage capacity between models and also for differences in volume handled for any given model (table 9). For example, difference in managers' salaries between models handling the same volume was $400 per 100,000 bushels of maximum storage capacity. In addition, the managers' salaries differed $300 for each difference of 100,000 bushels in volume handled. Thus, the difference in the managers' annual salaries between a 100,000-bushel model with 90,000-bushel maximum storage capacity handling 600,000 bushels and a 200,000-bushel model with 180,000-bushel maximum storage capacity handling 800,000 bushels would be $960. Wages of other employees can be reconstructed in the same manner.

Appendix table 2 shows the total annual personnel expense allocated to the three functions for each model at base volumes.

Personnel Expenses for Storage

Personnel expenses were charged to the storage function on the basis of the estimated direct labor used. Differences in such charges between models were directly related to the base storage levels of the models. Differences in charges for a given model were directly related to the levels of storage.

Table 9.--Schedule of salary and wage graduations used in budgeting total personnel costs

Employee	Salary and wage change per 100,000-bu. change in: Maximum storage capacity (Between models)	Volume handled (For a given model)
	(dollars)	
Manager	$400	$300
Bookkeeper	75	100
Elevator	100	100
Warehouse man	75	50
Second elevator man	100	100

Table 10.--Graduations used in budgeting personnel expenses for the storage function

Employee	Change in storage wages per 100,000-bu. change in: Typical storage level between models	Any storage level for a given model
	(dollars)	
Manager	$200	$133
Bookkeeper	50	50
Elevator man	100	50

Rates of change in the personnel expense charged to the storage functions were established for differences in base storage level between models and also for differences in volume stored for any given model (table 10). For example, the difference in managers' salaries between models storing at base storage levels was $200 per 100,000 bushels of storage. For a given model, managers' salaries differed an additional $133 for each 100,000 bushels of storage. Thus, the difference in the portions of managers' salaries charged to the storage function for a 100,000-bushel elevator storing 45,000 bushels and a 200,000-bushel elevator storing 180,000 would be $210.

Personnel Expenses for Sidelines

Personnel expenses were charged to the sideline function on the basis of the estimated direct labor used. Since the sideline sales volume was $100,000 for all models, a fixed personnel cost of $3,965 was charged to the sideline function regardless of grain volume handled or stored. Of this the cost of sideline bookkeeping and management was $1,800 and the cost of other labor $2,000. Workmen's compensation and social security totaled $165.

Personnel Cost of Merchandising and Handling

The personnel cost for grain merchandising and handling represented labor used for performing merchandising and handling functions plus idle time. No charge was made to the storage and sideline functions for idle time, since merchandising and handling was the primary function. The amount allocated to the merchandising and handling function was determined by deducting the allocation for the sideline and storage functions from the total personnel costs.

Other Personnel Expenses

The cost of workmen's compensation insurance and social security tax was included as a personnel expense and budgeted in the same manner as salaries and wages.

Workmen's compensation insurance costs were obtained by applying the average rate of $2.35 per $100 of payroll to total salaries and wages of each model. In actual operations the rate for the individual employee will vary with the risk associated with his work. The rates for the manager and elevator employees would be about $2.90, and for bookkeepers, about 8 cents per $100 of payroll.

Social security tax was calculated for FICA at the 2 percent rate on all individual wages up to $4,200 a year. Employment security tax was not included as an expense.

Other Variable Expenses

Other variable expenses included all variable expenses except personnel expenses. They comprised 16 to 23 percent of total expenses for the various elevator models at base volumes handled and stored (table 13).

Advertising

Advertising expense included ads placed with local newspapers and radio stations relating to feed, fertilizer, and other farm supplies. There was no advertising associated with grain; therefore, all advertising expense was allocated to the sideline function. A charge of $200 was made for all models since all had the same size of sideline operation.

Auditing

The cost of performing the audit of an elevator varies with the number and type of business transactions which reflect volume handled, volume stored, the bookkeeping system, and bookkeeping practices.

It was assumed that the larger elevator models would have a more extensive bookkeeping system because of the greater workload occasioned by the increased amount of storage and handling volume. Good bookkeeping practices were assumed for all models.

In budgeting, the auditing costs were related to storage capacity, volume of grain handled, and storage utilization. In budgeting between models, total auditing expenses at base volumes differed $33 per 100,000 bushels of volume and $10 per 100,000 bushels of maximum storage capacity. In budgeting for a given model, auditing costs for the merchandising and handling function changed $20 for each change of 100,000 bushels in volume handled; and for the storage function, $5 for each change of 100,000 bushels in storage level.

In allocating total auditing expenses at base volumes handled and stored, $275 was charged to the sideline function. Of the remaining amount attributed to the grain functions, 10 percent was charged to the grain storage function and 90 percent to the grain handling and merchandising function.

Bad Accounts

Failure to collect accounts receivable from sideline sales accounted for all the loss associated with bad accounts. Although a strictly cash operation would not have loss from bad accounts, it was assumed that all elevator models granted some credit and a resulting loss of $200 was charged to the sideline function.

Directors' Fees

Directors attending board meetings incurred expenses for time and travel. Fees were not related to volume or size of elevator; therefore, all models had the same cost for directors' fees. It was assumed that a five-man board attended 10 meetings at $6 a meeting, totaling $300 annual directors' fees for each model.

An allocation of $50 was made to the sideline function. The remaining amount was allocated to the grain functions on a 9 to 1 ratio, except for the 30,000-bushel model where all was allocated to merchandising and handling.

Donations

Contributions made to various civic and charitable organizations varied with the size and handling volume of the model. The variation in total donations between models was $15 for each change of 100,000 bushels in base volume. For a given model, donations changed $10 for each 100,000 bushels in volume handled. The level of storage utilization was not related to donations.

In allocating donations to the functions at base volumes handled and stored, a flat charge of $15 was made to the sideline function for all models. Of the remaining amount, 90 percent was allocated to merchandising and handling and 10 percent to storage, except for the 30,000-bushel models which did not store grain.

Dues and Subscriptions

Dues included amounts paid for memberships in civic organizations, farm organizations, and various trade organizations. Subscriptions covered cost of trade newspapers and magazines, market service reports, and other similar services.

Variations in total dues and subscriptions were related to size of elevator and volume handled. Storage utilization did not influence such costs. Total costs were budgeted to differ between models at $10 per 100,000-bushel difference in base volume handled. For a given model, such costs changed $5 for each 100,000 bushels in volume handled. A total of $15 was allocated to the sideline function and all of the remaining amount went to the merchandising and handling function.

Heat

It was assumed that a fuel oil was used to heat the office. The expense of heating varied slightly with the size of model. Volume handled or stored did not influence heating costs.

In budgeting between models, total heat expense varied $5 for each 100,000 bushels difference in maximum storage capacity. An allocation of $15 was made to sidelines and the remainder to the grain merchandising and handling function.

Insect Control

The expense of insect control included fumigation, bin spray, and mill spray. The cost of fumigants and sprays was more directly related to volume stored than to total volume handled.

The storage function was charged for the expense of fumigating the stored grain twice and using a moth spray three times at a total annual cost of $5.40 per 1,000 bushels.

In figuring the cost of fumigation chargeable to the merchandising and handling function, it was assumed that 5 percent of the volume handled was fumigated once at a cost of $2.70 per 1,000 bushels. The merchandising and handling function was also charged for bin spray which was used once annually at the rate of 1 gallon per 750 square feet of surface.

Insurance on Merchandise

The cost of fire and extended coverage insurance for inventories of grain and sidelines depends on the rates and value of the inventory. Insurance rates used for each model were the same as for buildings and equipment. An insurable value of $2 a bushel of grain inventory was used. A sideline inventory of $15,000 was assumed.

Sideline inventories included feed, seed, fertilizer, and building supplies. The insurance rate was $1.16 per $100 of coverage, making a total charge of $174 to the sideline function.

Grain was held in the models for short periods as well as long periods. Insurance on grain held over 30 days in the account of the farmer, C.C.C., or the elevator was charged to the storage function. All such grain was held in the new storage facilities.

Insurance on grain held under 30 days was allocated to the merchandising and handling function. Such grain was stored in both the old and the new grain storage facilities. This short-term inventory was assumed to average 4 percent of the maximum storage capacity of the model plus 5,000 bushels. The old 30,000-bushel elevator averaged 2,500 bushels of storage when associated with concrete tanks and 5,000 bushels when with concrete elevators or flat storage.

Interest on Seasonal Capital

During each harvest, seasonal capital is needed to make payments for grain received and for increased elevator expenses such as labor, plant supplies, and repairs. Additional capital is also needed to finance seasonal demands for increased inventories and accounts receivable associated with sales of sidelines such as fertilizer.

Maximum seasonal capital requirements for grain during any one harvest depend upon many factors such as volume handled, amount of money received on drafts, value per bushel, demands by farmers for settlement, and ability to ship and settle accounts quickly.

It was assumed that the requirements for seasonal capital to handle grain were directly related to volume handled, and that seasonal capital was required at a specified level for a total time of 2 months. All interest expense on seasonal capital was accrued at the annual rate of 4 percent (table 11). Interest on seasonal capital changed $17 for each 100,000 bushels in volume handled.

Seasonal capital requirements for sidelines was assumed to be $3,000 for a 2-month period. At 4 percent interest, the total interest allocated to the sideline function was $20.

Table 11.—Average seasonal capital requirements and interest cost by operating function, at base volume handled

Model	Ave. seasonal capital used			Total	Cost at 4% interest	
	Side-lines	Merch. and handling	Storage		Side-lines	Merch. and handling
(1,000 bu.)	(dollars)					
Old 30-bu. wood	$3,000	$ 5,000	-	$ 8,000	$20	$33
New 30-bu concrete	3,000	5,000	-	8,000	20	33
Old 30-bu. + two 20-bu. concrete tanks	3,000	7,500	-	10,500	20	50
Old 30-bu. + four 25-bu. concrete tanks	3,000	10,000	-	13,000	20	67
Old 30-bu. + 60-bu. concrete	3,000	12,500	-	15,500	20	83
Old 30-bu. + 100-bu. concrete	3,000	15,000	-	18,000	20	100
Old 30-bu. + two 55-bu. flat	3,000	5,000	-	8,000	20	33
Old 30-bu. + 200-bu. concrete	3,000	20,000	-	23,000	20	133
Old 30-bu. + 400-bu. concrete	3,000	25,000	-	28,000	20	167

Legal

Legal expense was a small expense item generally associated with organization, financing, and property papers. It varied slightly with size and volume. An allocation of $10 was made to sidelines and the remainder to merchandising and handling.

Lights

Light expense included 110-volt power used for lighting office space, warehouse, and elevator. The use of light was related to volume handled, volume stored, and size of elevator. The larger models had higher light expense than smaller models at the same volumes handled. The expense of lights for a given model changed $2 for each 100,000 bushels in volume.

A total of $7 was allocated to sidelines. A charge was made to the storage function based upon the estimated power usage for lights associated with storage. The remainder was charged to merchandising and handling.

Meetings and Member Relations

The expense of planning and conducting membership meetings included the rent for the meeting place, cost of entertainment and refreshments, prizes, meeting notices, and printing statements. Member relations included newspaper notices, calendars, small complimentary gifts, and other such expense items incurred for the benefit of members.

Expenses changed $20 for each 100,000 bushels of volume handled. A flat $30 was allocated to sidelines for all models. All other expense was allocated to merchandising and handling.

Miscellaneous Expenses

In this expense class are included those that could not be logically put in the other expense classes. It included such items as licenses, fees, bank service charges, loss on fixed assets sold, and collection expense.

Total miscellaneous expense was budgeted to change $5 for each 100,000 bushels of volume. An allocation of $50 was made to the sideline function and the remainder to grain merchandising and handling.

Office Supplies

The cost of office supplies included tickets, bookkeeping supplies, invoices, stationary, postage, machine service, checks, and other office supplies.

In budgeting between models, total expense changed $25 for each 100,000 bushels of base handling volume. For a given model, total expense changed $15 for each 100,000 of volume handled and an additional $5 for each 100,000 bushels of stored grain.

The merchandising and handling function was allocated with all the office supply expense that would have been incurred regardless of secondary functions. An allocation was made to the storage function equal to 9 percent of the allocation to the merchandising and handling function to cover additional expense incurred for records and other supplies.

Sidelines made up an important part of required office supplies because of the number of sideline transactions compared to grain transactions. Credit sales associated with sidelines added to such expense. A total of $150 was allocated to the sideline function.

Plant Supplies

This expense included such items as petroleum products, fire extinguisher refills, rodent control, sacks, grain scoops, brooms, containers, fuses, and many other supplies of a miscellaneous nature.

Plant supplies for a given elevator model were budgeted to change $6 for each 100,000 bushels handled and $4 for each 100,000 bushels stored. Differences between models were based upon the case study analyses.

The allocation of plant supply expenses to the grain functions was the same as used in allocating the fixed expenses associated with the equipment. A total of $80 was allocated to sidelines.

Power

Total power consumption by all models varied with the connected horsepower, number of times grain was elevated, and the volume of grain handled.

The average cost per kilowatt hour depends upon the rate schedule and the number of kilowatt hours used. The power cost allocated to each of the three functions depends upon the kilowatt hours used by each function, and upon the order in which the rates are applied to the kilowatt hours of each function. Power costs are first calculated for the primary function and then for the secondary functions.

In order to obtain a basis for kilowatt consumption per bushel elevated, field observations were made of country elevators. Power consumption readings were made while grain was being elevated at the normal rate. It was found that elevating 200 bushels of grain required an average of one kilowatt of power. All grain handled was assumed to have been elevated twice. All grain stored was assumed to have been elevated an additional three times for turning purposes. The power consumed by the sideline function was based upon 52 hours of feed mill operation each month for all models. On the basis of the above information and assumptions, it was possible to estimate the monthly power consumption for each function of each model at the various volumes handled.

In actual practice, power consumption may vary sharply between months, but because of inadequate seasonal data it was assumed that power usage was the same for all months. The monthly power consumption was used so as to reflect the effect of the minimum monthly power rates on monthly power costs.

Monthly minimum power costs were based upon connected horsepower. The assumed connected horsepower for each model is shown in table 12. All connected horsepower applied to the grain functions for all models except for the 49½ hp. used in the feed mill. The monthly minimum charge used for all models was 65 cents a kilowatt of connected load.

The rate schedules used in Illinois varies only slightly between the different power companies. The rates used for this study were as follows:

Kilowatt hours	Cents per kw. hr.
First 80	7.5
Next 150	6.0
Next 770	4.4
Next 3,000	3.0
Next 4,000	2.5

This rate schedule was applied to the average monthly power used to obtain average monthly power costs for each function of each model. Average monthly power costs were multiplied by 12 to obtain annual power costs. For example, the 100,000-bushel model handling 400,000 bushels of grain annually and storing 45,000 bushels had power consumption and costs as follows:

Function	Monthly power consumption kw. hr.	Monthly power cost	Annual power cost
Grain merchandising and handling	590	$44	$528
Grain storage	57	-	-
Sidelines	1,508	38	456
Total	2,155	$82	$984

The 100,000-bushel model used 1,956 kw. hrs. resulting in a monthly charge of $82. This model had an 89½ connected horsepower for the merchandising and handling function, or about 67 kilowatts. The minimum of 65 cents a kilowatt of connected load resulted in a charge of $44 to the merchandising and handling function, since the normal rate schedule applied to 590 kw. hrs. would have made a charge of only about $32. The power used by both grain functions totaled only $33 when using the normal rate schedule; thus no charge was made to the storage function. The power charge to the sideline function was the difference between the total power cost and the power charge to the grain functions. Monthly costs converted to the annual rate totaled $984.

Repairs and Maintenance

The expense of repairing and maintaining elevator equipment and facilities varies from year to year. The expenses budgeted represented an average annual expense expected for the models. Expense of repairing and maintaining the

Table 12.-Connected horsepower for each model by location of motor

Model	Location of motors: Old elevator	New elevator	Feed mill	Sheller cleaner	Total connected horsepower
	(horsepower)				
Old 30,000-bu. wood	23	-	49½	32	103½
New 30,000-bu. concrete	-	23	49½	32	103½
Old 30,000-bu. + two 20,000-bu. concrete tanks	23	15	49½	32	118½
Old 30,000-bu. + four 25,000-bu. concrete tanks	23	30	49½	32	133½
Old 30,000-bu. + new 60,000-bu. concrete	23	33	49½	32	136½
Old 30,000-bu. + new 100,000-bu. concrete	23	35½	49½	32	139
Old 30,000-bu. + two 55,000-bu. flat	23	3	49½	32	106
Old 30,000-bu. + 200,000-bu. concrete	23	50½	49½	32	154
Old 30,000-bu. + 400,000-bu. concrete	23	90½	49½	32	194

models increased with the size and volume handled. Change in costs between models handling base volume was related to change in cost of facilities as well as to volume.

For a given model, some repair and maintenance expenses were closely related to volume handled while others were influenced little or none by volume. Considering these factors, total expenses for a given elevator were budgeted to change $40 for each 100,000 bushels of grain stored. An allocation of $200 was made to sidelines. The method of allocating between the storage and handling function was the same as was used for depreciation.

Scales

The scales were assumed to have been checked for accuracy and minor adjustments made at least once a year. All truck scales were of the same type. The loading out scales were of greater capacity for the larger elevators. Greater use of scales resulted in the need for more frequent inspections and more adjustments. Thus, total scale expense was budgeted to increase with volume handled.

Total scale expense changed $7 for each 100,000 bushels of volume. Since the truck scale was used for sidelines, that function was charged $5 for all models. Since no allocation was made to the storage function all remaining scale expense was charged to merchandising and handling.

Shrinkage and Quality Deterioration

Shrinkage and quality deterioration were included as expenses because they vitally influence net operating results. However, they are not normally shown as an expense item in regular operating statements or audits.

The combined cost of shrinkage and quality deterioration charged to the merchandising and handling was one-half of a cent a bushel of grain handled for all models. The charge to the storage function was three-fourths of a cent a bushel of assumed storage level in all concrete elevator and tank models which store grain. For flat storage the combined cost charged to the storage function was 2 cents a bushel.

Shrinkage

Shrinkage in weight includes moisture loss and physical loss due to rodents, insects, and unrecovered spillage. The amount of shrinkage was assumed to be at the rate of one-fourth of 1 percent a bushel handled through either the wood elevator, concrete elevators, or concrete tanks. An additional one-fourth of 1 percent was charged to the volume stored in such elevators. For the flat storage model the shrinkage was set at three-fourths of 1 percent a bushel handled, and an additional one-fourth of 1 percent for grain stored. Grain was valued at $2 a bushel to determine shrinkage cost.

Quality Deterioration

Since elevators were assumed to have been under good management, no quality deterioration was figured for the merchandising and handling function. The quality deterioration for the storage function was set at one-fourth cent a bushel of assumed storage level in the concrete elevator and tank models. The quality deterioration for the flat storage model was twice as high or one-half cent a bushel.

Telephone and Telegraph

In addition to local service, telephone expense included long-distance calls relating to grain merchandising, elevator equipment and repairs, sideline purchasing, membership, and other business. Telegraph expense generally pertained to special circumstances and was relatively less important.

An allocation of $24 was made to the sideline function, and all other expense was allocated to the merchandising and handling function which changed $25 for each 100,000 bushels of volume handled.

Travel

The manager, directors, and employees incurred travel expense. The manager and some of the directors traveled together to the annual meeting of the regional grain cooperative. Travel expense also included going to schools such as grain grading or bookkeeping, and calling on patrons to collect overdue accounts on sideline sales.

A total of $20 was allocated to the sideline function and the remainder to merchandising and handling. For a given model, travel expense changed $8 for each 100,000 bushels.

Water.

Water expense was relatively small for all models. Water was used primarily in the office. Cost increased only slightly with size and volume. An allocation of $5 was made to sidelines, and the rest was charged to merchandising and handling.

ANALYSIS OF FIXED AND VARIABLE EXPENSES

Total expenses for the grain functions were made up of fixed and variable expenses. These two groups of expense differed sharply in their response to volume changes. That is, their unit costs changed at different rates. Unit fixed costs generally declined sharply with volume increases while unit variable costs usually declined at a moderate rate. In addition, the relative importance of each of these expense groups differed at the various volumes handled and stored as will be shown. Fixed and variable expenses associated with the sideline function are not discussed here since they remain the same for all models at all volumes.

Fixed Expenses

Fixed expenses include depreciation, insurance, property taxes, railroad lease, bonds and licenses, and interest on long-term capital. All of these expenses normally remain at a relatively constant 4/ level from year to year regardless of volume. However, such unit costs of handling and storing grain decline rather sharply with increases in volume. Thus, it behooves elevator management to provide a facility which can handle expected volume increases and then to plan to use the facility as near capacity as possible.

Merchandising and Handling

The larger concrete elevator models had greater total fixed expenses, but they could keep their unit fixed costs below competitive levels by maintaining a high grain merchandiseturnover. At the base volume of 800,000 bushels, the new 200,000-bushel model had the lowest fixed cost at 1.4 cents a bushel (table 13). Costs for the new 400,000-bushel model were slightly higher because of the added facility value. On the other hand, the new 30,000-bushel model had fixed costs of 4.3 cents a bushel at a base volume of 200,000 bushels, which indicates that a small new concrete elevator can be at a serious disadvantage from the standpoint of fixed costs if a nearby firm has adequate volume to operate a larger elevator at, or near, handling capacity.

Total fixed expenses for the old 30,000-bushel model, the concrete tank models, and the flat storage model were relatively low. At a given volume these models had lower fixed costs than concrete elevators. At base volumes, unit fixed costs for these models ranged from 1.5 cents to 2.2 cents. Such low unit costs tended to place these elevators in a relatively favorable cost situation when fixed costs alone were considered.

Fixed expenses for the new 60,000-bushel model were not significantly different from those of the new 100,000-bushel model because the equipment required for both was about the same and construction cost per bushel was less for the larger model.

4/ Some decline in fixed costs will normally occur as the investment requirement declines with the amortized value.

Table 13.—Total costs and costs per bushel by the three major operating functions for the elevator models at base volume levels 1/

Elevator model	Total Sidelines	Merchandising and handling: Fixed	Merchandising and handling: Personnel 2/	Merchandising and handling: Other variable	Merchandising and handling: Total	Storage: Fixed	Storage: Personnel	Storage: Other variable	Storage: Total	Total all functions: Fixed	Total all functions: Personnel	Total all functions: Other variable	Total all functions: Total
(1,000 bu.)	(dollars)												
Old 30 wood	$11,199	$4,442	$7,784	$3,742	$15,968	$ -	$ -	$ -	$ -	$9,815	$11,749	$5,603	$27,167
New 30 concrete	11,199	8,586	7,784	3,042	19,412	-	-	-	-	13,959	11,749	4,903	30,611
Old 30 + two 20 concrete tanks	11,151	5,994	9,139	4,568	19,701	1,748	736	443	2,927	13,115	13,840	6,824	33,779
Old 30 + four 25 concrete tanks	11,115	6,627	10,379	5,390	22,396	4,114	845	1,079	6,038	16,114	15,189	8,246	39,549
Old 30 + 60 concrete	11,115	10,150	11,442	5,792	27,384	2,649	772	559	3,980	18,172	16,179	8,128	42,479
Old 30 + 100 concrete	11,139	10,446	13,611	6,564	30,621	4,024	845	936	5,805	19,843	18.421	9.301	47,565
Old 30 + two 55 flat steel	11,259	4,446	9,600	4,504	18,550	4,295	900	2,033	7,228	14,114	14,465	8,458	37,037
Old 30 + 200 concrete	11,151	11,114	15,965	8,239	35,318	7,586	1,010	1,759	10,355	24,073	20,940	11,811	56,824
Old 30 + 400 concrete	11,019	14,727	20,076	10,064	44,867	14,462	1,339	3,387	19,188	34,562	25,380	15,132	75.074
		(cents per bushel handled)				(cents per bushel stored)				(Percent of total)			
Old 30 wood	-	2.22	3.89	1.87	7.98	-	-	-	-	36	43	21	100
New 30 concrete	-	4.29	3.89	1.53	9.71	-	-	-	-	46	38	16	100
Old 30 + two 20 concrete tanks	-	2.00	3.04	1.53	6.57	11.65	4.91	2.95	19.51	39	41	20	100
Old 30 + four 25 concrete tanks	-	1.66	2.60	1.34	5.60	9.14	1.88	2.40	13.42	41	38	21	100
Old 30 + 60 concrete	-	2.03	2.29	1.16	5.48	10.60	3.07	2.23	15.90	43	38	19	100
Old 30 +100 concrete	-	1.74	2.26	1.10	5.10	8.94	1.88	2.08	12.90	42	39	19	100
Old 30 + two 55 flat steel	-	1.48	3.20	1.50	6.18	7.16	1.50	3.39	12.05	38	39	23	100
Old 30 + 200 concrete	-	1.39	1.99	1.03	4.41	8.43	1.13	1.95	11.51	42	37	21	100
Old 30 + 400 concrete	-	1.47	2.01	1.01	4.49	8.03	.75	1.88	10.66	46	34	20	100

1/ See Table 3 for base volumes of each model
2/ All personnel expense is considered as variable expense.

Storing

Fixed expenses play an important role in the total cost of storage. They are important because they make up the major portion of storage costs and even more important because of their relation to volume. Unit fixed costs decline rapidly as storage utilization increases. This relationship is pertinent to all types of elevators built for storage.

At the same storage volume for all models, the smaller elevators had distinctly lower fixed costs. On the other hand, when a comparison was made at either base or maximum storage levels there was a thin margin of advantage for the larger elevators. For example, at the 60,000-bushel storage level, the 100,000-bushel concrete model had a fixed storage cost of 6.7 cents a bushel compared to 12.6 cents for the 200,000-bushel model (appendix table 6). At base storage levels, these costs became 8.9 cents and 8.4 cents, respectively.

Unit fixed costs for storing grain in the four 25,000-bushel concrete tank models were only slightly higher than for the 100,000-bushel concrete elevator model. However, it should be kept in mind that the latter had more bins and thus had greater flexibility for handling stored stocks.

The two 55,000-bushel flat storage model had unit fixed cost of 7.2 cents at the 60,000-bushel storage level, or roughly one-half cent higher than for the two models just mentioned. In evaluating this unit-cost difference it must be remembered that the flat storage model was designed primarily for storing grain, while the other elevator models were designed primarily for handling grain. The flat storage model provides less flexibility in handling stored grain than the concrete tank models. On the other hand, it is equipped with temperature detecting equipment and aeration which lessens the probability of having to turn the grain.

Variable Expenses

Variable expenses include expense items that are affected by changes in volume. Personnel expense is the largest variable expense. Shrinkage and quality deterioration, repairs and maintenance, and power expense also comprise important portions of variable expenses.

Some variable expenses are termed "sticky" because of their slow response to volume changes. It is necessary to know the degree of "stickiness" or the response to volume changes for each expense item in order to budget expenses for various volumes handled and stored.

Merchandising and Handling

Since merchandising and handling is the primary function, it bears all the variable expense except what can be directly attributed to the secondary functions—grain storage and sidelines. This means that the primary function is charged with actual inputs plus excess or idle inputs necessitated by the nature of the operation.

Additional units of volume handled in the elevator models incurred progressively less variable expense per bushel. Thus, the rate of decline in unit costs was greatest at the lower volume levels and gradually subsided as volume increased causing a leveling of the cost-volume curve (figure 5).

Unit variable costs at a given volume handled were slightly greater for the larger concrete model elevators because of the increased complexity and scope of operations. This difference, however, was not great. A comparison of unit variable costs for the 30,000-bushel and the 400,000-bushel elevator models revealed a peak difference of 1.1 cents at 200,000 bushels of volume. This difference was reduced to 0.4 cents a bushel at 500,000 bushels of volume. A similar relationship existed among the other model elevators.

Total variable costs per bushel for the concrete tank models and for flat storage tended to follow the same pattern and level as for the new 30,000-bushel concrete elevator (figure 6). Variable costs per bushel for the old wooden 30,000-bushel elevator at 200,000 bushels of volume were 5.8 cents compared to 5.4 cents for the new 300,000-bushel elevator (appendix table 8). This difference was due to the higher expense of repairs, maintenance, plant supplies, and insurance for the old elevator.

Storing

Variable costs of storing grain in the new concrete elevator models did not differ greatly at similar volumes stored (figure 7). At a given storage volume, the larger elevators had the higher cost of storage. Above 90,000 bushels of storage volume, variable costs per bushel declined slowly for the two larger model elevators. For example, variable costs of storage for the 400,000-bushel model dropped only 1.2 cents from the 90,000-bushel to the 360,000-bushel storage level.

At base storage volumes, the variable costs of storing were lower for the larger concrete elevator models, ranging from 5.3 cents a bushel for the 60,000-bushel elevator to 2.6 cents for the 400,000-bushel elevator.

Variable costs of storage for the flat storage models were slightly over 1 cent a bushel greater than for the concrete tank model of similar capacity (appendix table 9). Greater expense of shrinkage and quality deterioration assumed in flat storage accounted for this difference.

A Comparison of Fixed and Variable Costs

The characteristic differences between fixed and variable costs per bushel were: (1) the rate of decline in unit costs, (2) the variation between models, and (3) the general level of such expenses. Fixed costs per bushel declined rapidly with increases in volume, and there was a large difference in fixed costs between the various model elevators at the same volume.

On the other hand, variable cost per bushel declined more slowly with volume increases and did not differ greatly between the various sizes and types of elevators. For the merchandising and handling function, the level of variable expenses was higher than for fixed expenses and the spread between the two expense groups widened as volume increased (figures 5 and 6). For the storage function, fixed expenses exceeded variable expenses and the

Figure 5

Fixed and Variable Costs of Merchandising and Handling Grain for Specified Elevator Models at Various Volumes

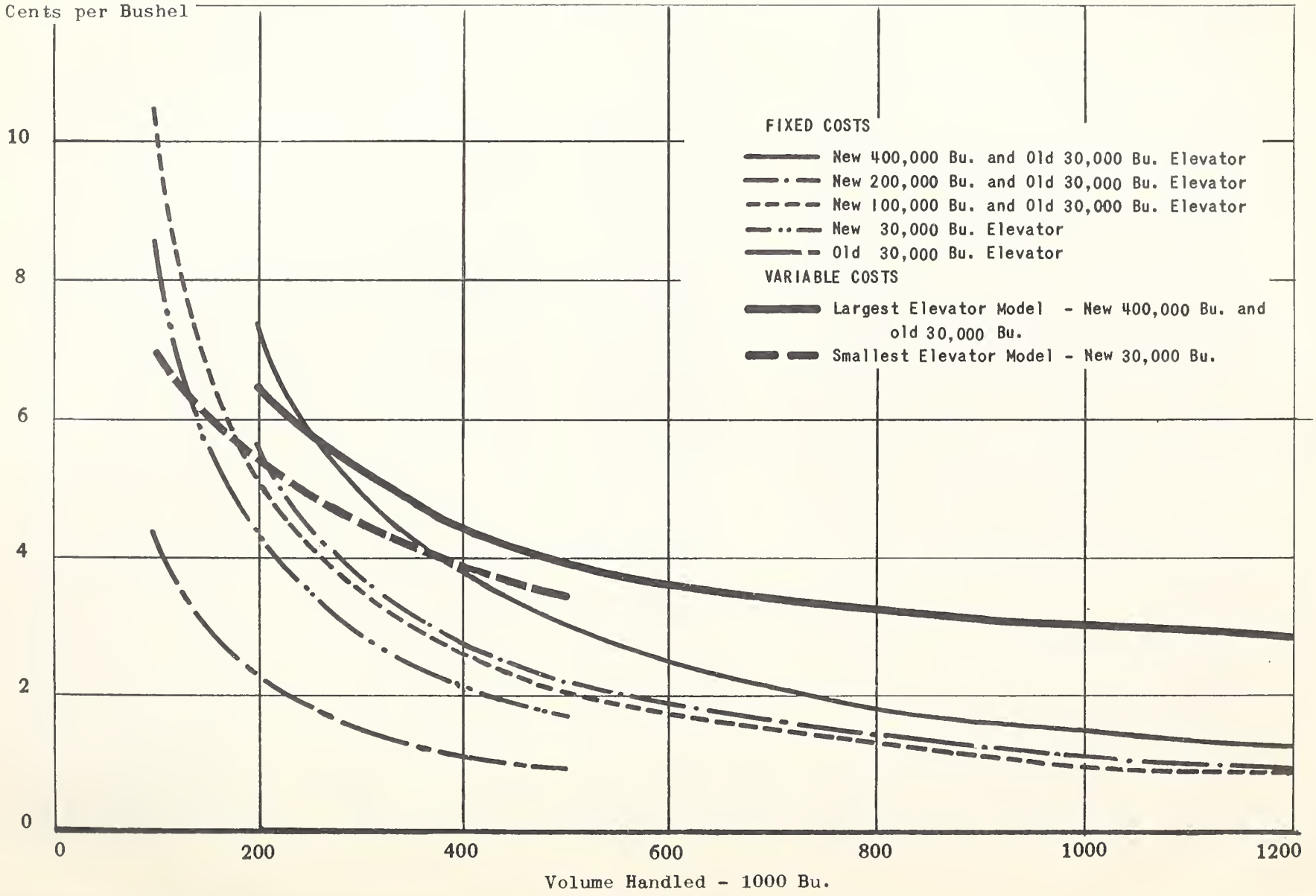


Figure 6

Fixed and Variable Costs of Merchandising and Handling Grain for Concrete Tank and Flat Storage Elevator Models at Various Volumes

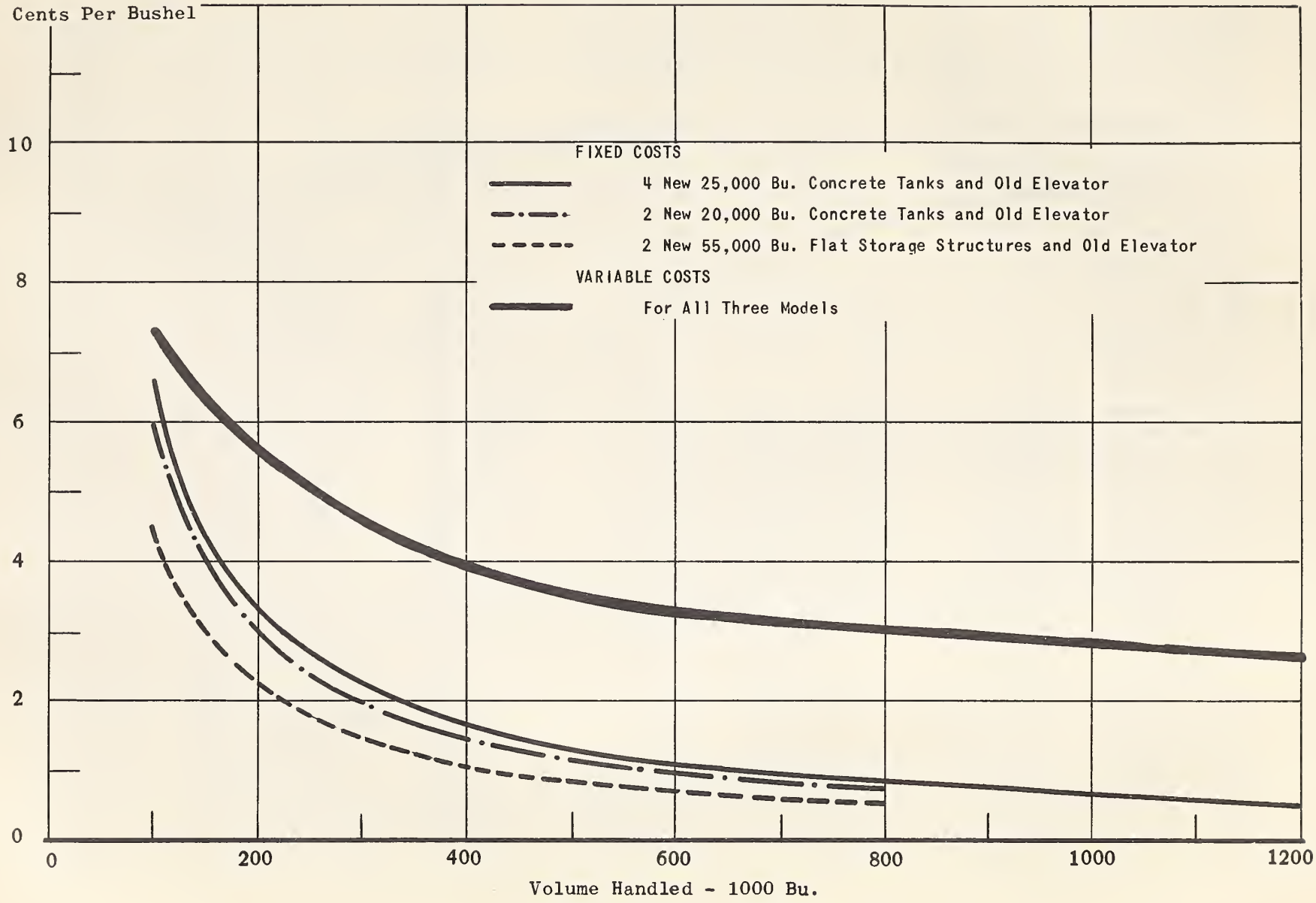
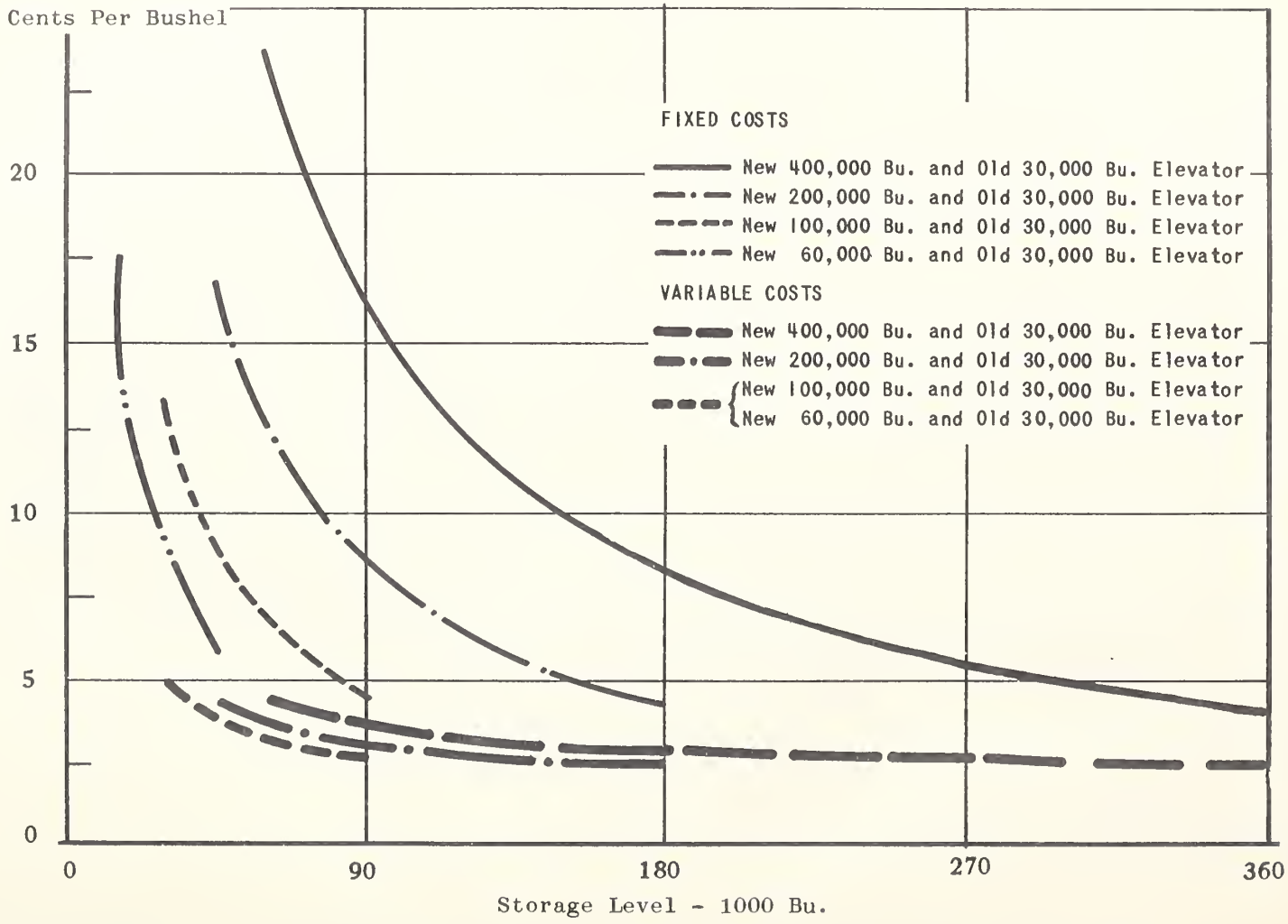


Figure 7

Fixed and Variable Costs of Storing Grain for New Concrete Elevator Models at Various Storage Levels



spread between the two expense groups narrowed as storage volume increased (figure 7).

The use of concrete tanks operating in conjunction with an old elevator permits lower fixed costs of handling compared to a new concrete elevator. However, there is no cost advantage for concrete tanks in performing the storage function (appendix tables 6 and 7).

Since fixed expenses have such an important influence upon total costs of handling and storing grain, careful attention should be given to the choice of facilities and their costs. The type of facility should be the type that will perform the desired functions and give the desired flexibility for the anticipated volume.

ANALYSIS OF TOTAL EXPENSES

Total expenses include fixed and variable expenses for all three functions: (1) Merchandising and handling, (2) storage, and (3) sidelines. The expense of grain merchandising and handling as the primary function comprised the major portion of total expenses. Grain storage expense increased in relative importance as the size of elevator increased. Sideline expenses remained constant at around $11,000.

Shrinkage, quality deterioration, and interest on long-term capital are expense items included in this study which do not normally appear in an operating expense statement. However, these items represent sizable costs, which can have an important influence upon the success of any country grain elevator operation.

Unit Cost of Merchandising and Handling Grain

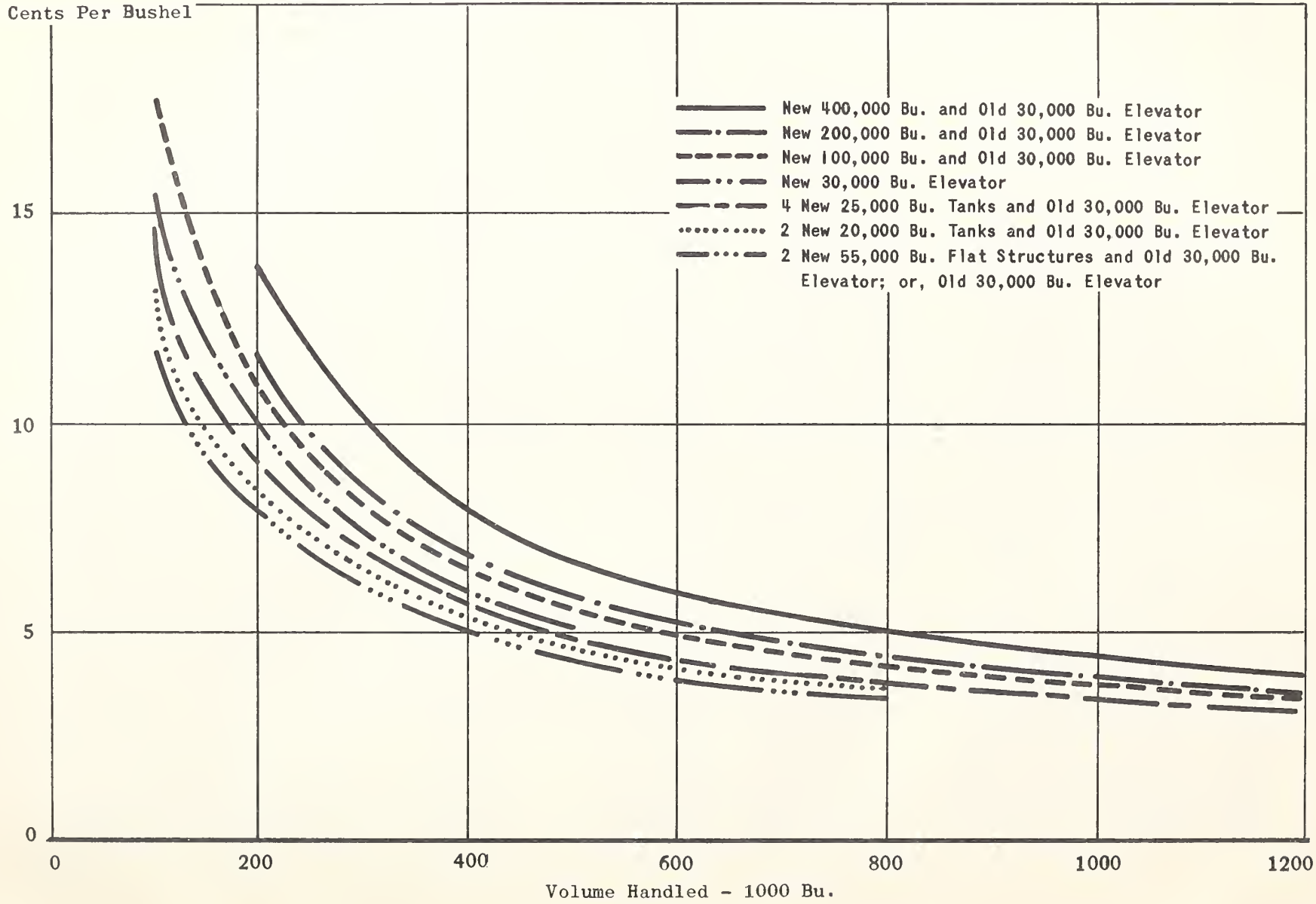
The cost of handling and merchandising a bushel of grain is a function of the volume and all of the many costs that are involved. Unit costs for a given elevator generally decrease with increases in the volume handled. Handling costs per bushel at the same volume for all models were greater for the larger elevators.

Economy in size of a facility and economy in volume handled play an important role in determining the competitive situation for a country grain elevator. For instance, the merchandising and handling costs at 400,000 bushels of volume were 8.1 cents for the 400,000-bushel elevator model compared to 6.5 cents for the 100,000-bushel elevator (figure 8). The larger elevator would have to increase its volume to 530,000 bushels to obtain a unit cost of 6.5 cents a bushel. Thus, the larger concrete elevators must handle considerably larger volumes than the smaller elevators of comparable type and design in order to maintain the same unit costs.

Merchandising and handling costs at a given volume were lowest for the concrete tank and flat storage model elevators operated with an old 30,000-bushel wood elevator. However, these elevator types are less flexible than

Figure 8

Total Cost of Handling and Merchandising Grain for Specified Elevator Models at Various Volumes



complete concrete elevators and less able to handle a larger volume on a daily or seasonal basis primarily because they have fewer bins and a slower receiving rate. Thus, service may be sacrificed for lower operating costs.

Unit Cost of Storing Grain

The total cost of storing a bushel of grain reflects the relationship between volume stored and total of all fixed and variable costs. Unit storage costs tend to decrease with increases in storage volume. As the cost and capacity of the elevator model increased, unit storage costs also increased for elevators of the same type.

At a given storage volume, there are important economies between elevators involving the size, cost, and type of elevator. Size of elevator and percent of capacity utilized influence many of the fixed and variable expenses of storage. Cost of the elevator directly affects only fixed expenses. Type of elevator affects both fixed and variable costs of storage, and also service to the patrons of the elevator.

At a 60,000-bushel storage level, the cost of storage for the 100,000-bushel concrete elevator model was 10.1 cents a bushel compared to 16.3 cents for the 200,000-bushel elevator (figure 9). In this instance, storage utilization was 67 percent and 33 percent, respectively. Thus, size and cost factors influenced a difference of over 6 cents a bushel in storage cost at the same storage level or volume. Similar relationships also existed among other models, some of which involve the type of elevator.

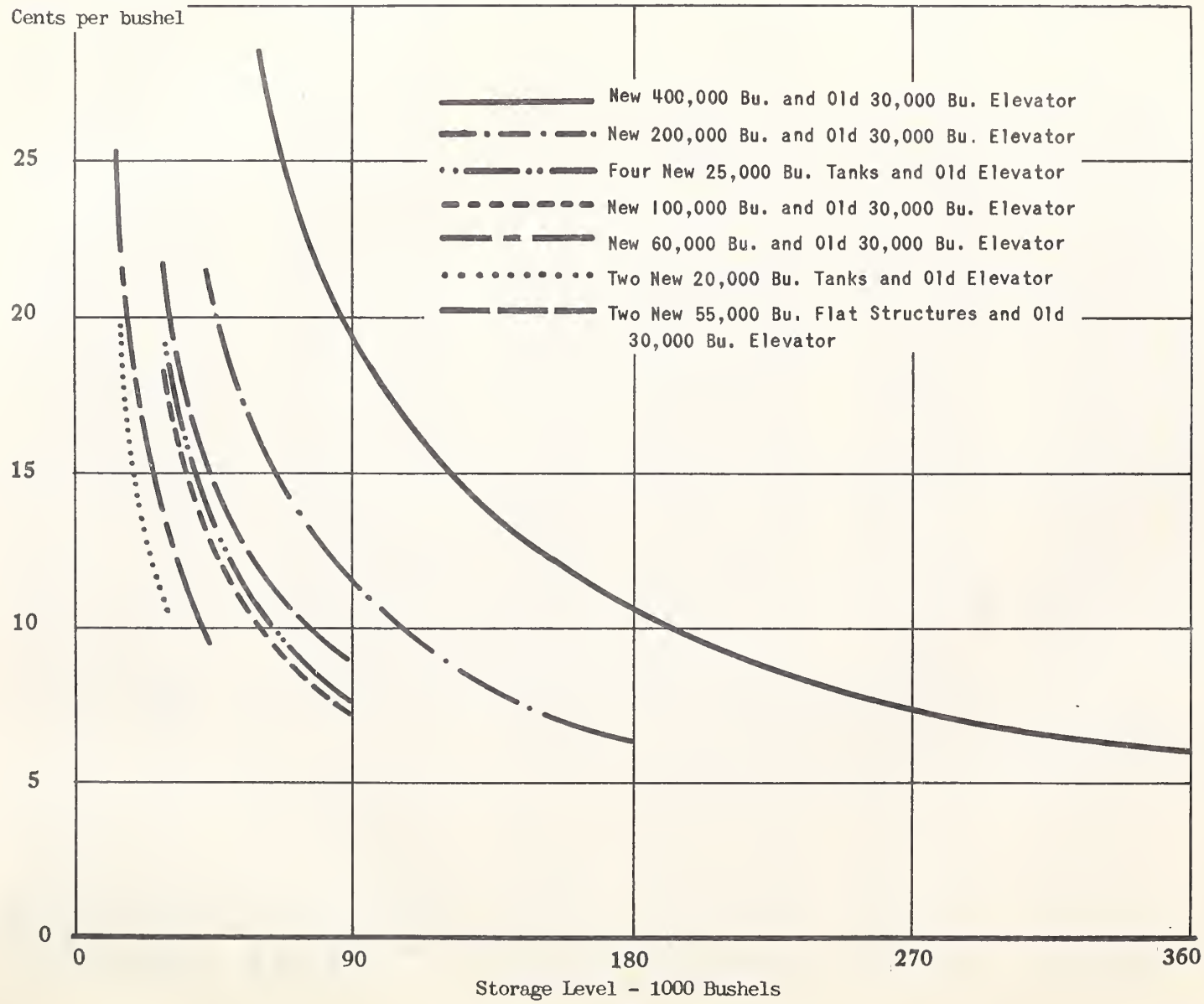
For the given elevator, economy of operation is definitely related to storage utilization. Storage costs per bushel for the 200,000-bushel model were 21.1 cents at the 45,000-bushel storage level compared to 6.7 cents at the maximum storage level of 180,000 bushels. Other elevator sizes and types had similar economics related to storage level.

At base and maximum storage levels, the larger elevator models generally had a lower cost of storage per bushel because of lower facility costs per bushel of capacity and ability of the larger elevators to store more grain per unit of labor utilized. Generally speaking, for reasonable economy in the storage of grain, the new elevator should have a capacity of at least 100,000 bushels. At base storage volumes the 60,000-bushel concrete elevator model had a storage cost of 15.9 cents compared to 12.9 cents for the 100,000-bushel concrete elevator.

In choosing the size of elevator it is important to estimate the expected relative use to be made of the elevator between the storage function and the merchandising and handling function. Where little or no storage is planned it may be wise to limit the size to 60,000 bushels or smaller. Nevertheless, in building any size of elevator, provisions should be made to permit subsequent adding of additional storage space at a minimum cost. Such provision might include planning for sufficient land space, a higher headhouse, a faster leg rate, or an additional leg.

Figure 9

Total Cost of Storing Grain for Specified Elevator Models at Various Storage Volumes



OTHER FACILITY SITUATIONS

The cost-volume relations previously discussed for the elevator models can be altered somewhat by higher construction costs, or by adding new equipment such as a dryer. During the past few years construction costs have risen sharply and may rise even more. In order to show the effect of higher facility costs, cost-volume relationships were developed for elevator models whose new facilities cost 30 percent more than assumed for the previous analyses in this study.

In order to show the effect of adding new equipment, cost-volume relationships were also developed for elevator models to which new equipment valued at $20,000 had been added. As a result, fixed costs were increased $2,400.

Effect of Higher Facility Costs

The possible higher cost of new facilities occasioned by increases in the cost of labor, materials, and equipment would naturally result in higher fixed expenses. The income-producing abilities of the elevator would not increase merely because of higher construction costs; therefore, management would normally strive to increase volume handled and stored so as to reduce unit costs.

Merchandising and Handling Costs

In order to illustrate the effect of higher facility valuation upon unit costs of merchandising and handling, the new facilities contained in the 100,000-bushel and 400,000-bushel concrete models were increased 30 percent in value. This caused an increase in the fixed costs of the merchandising and handling function of $2,391 for the 100,000-bushel model and $3,373 for the 400,000-bushel model. At base volumes handled the increased cost per bushel for these models was four-tenths cent and one-third cent respectively (appendix table 12). Figure 10 shows how the amount of increased cost per bushel declined for the larger volumes handled.

When facility costs increased, more bushels were required to maintain a given unit cost level in the larger elevators than in smaller, less expensive elevators. For example, in order for the 100,000-bushel elevator model to maintain a 6-cent cost level, after a 30 percent increase in facility value, an additional handling volume of 30,000 bushels was required; whereas, the 400,000-bushel model needed an additional 50,000 bushels (table 14).

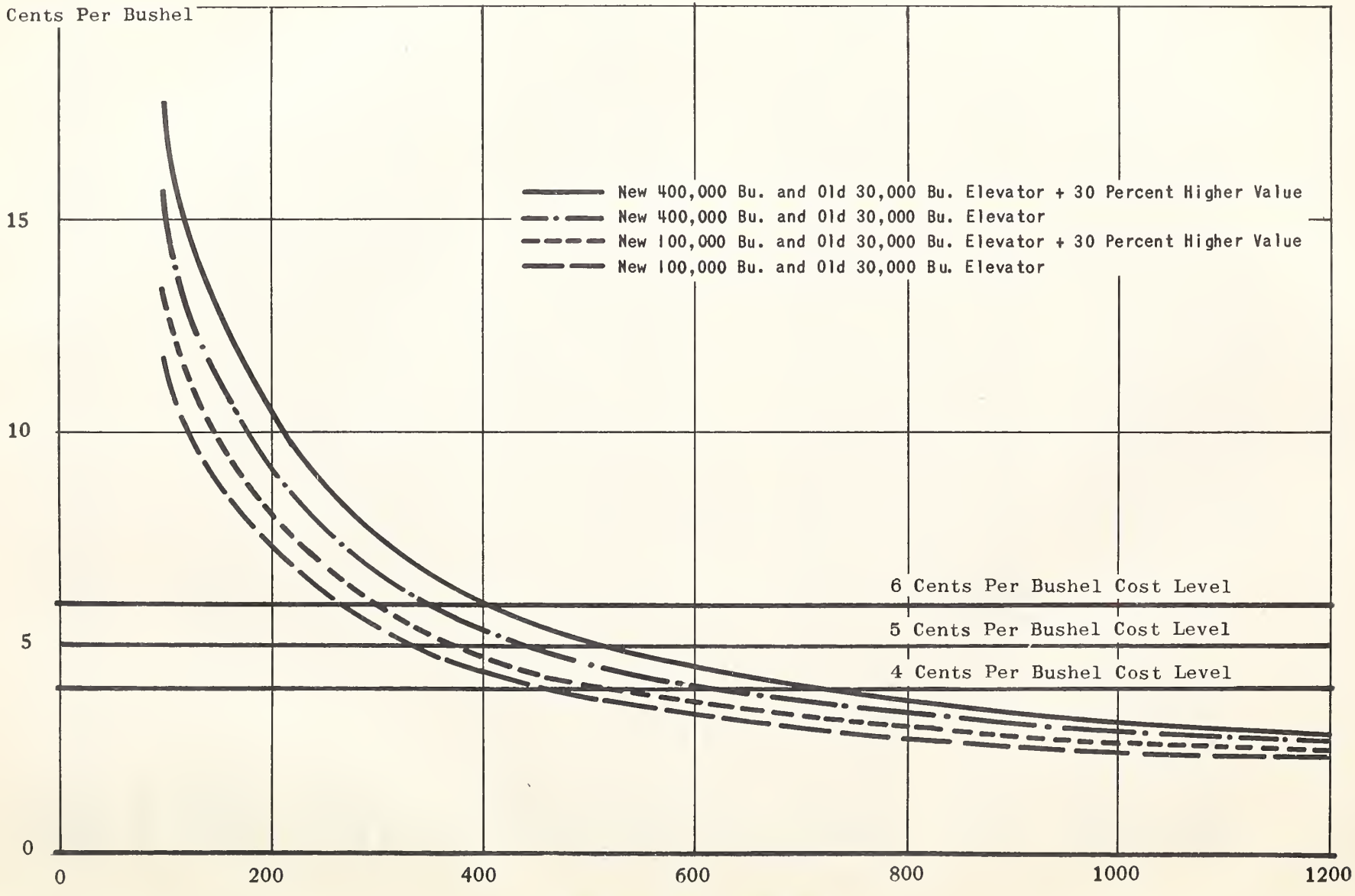
The additional bushels required to maintain unit handling costs were greater at the lower unit cost levels. The 400,000-bushel model required 50,000 bushels to maintain a 6-cent level; whereas, it needed 88,000 bushels to maintain a 4-cent level.

Storage Costs

Fixed expenses were relatively larger for the storage function than for the merchandising and handling function. Thus, the 30 percent increase in new facility costs had a greater effect upon storage costs than upon merchandising

Figure 10

Relation of Merchandising and Handling Costs to Volume Handled for New Concrete Elevator Models Valued at the Current Level and 30 Percent Higher



and handling cost.

As a result of the 30 percent increase in facility values, the 100,000-bushel elevator model had fixed costs for the storage function of $1,130 compared to $4,137 for the 400,000-bushel elevator. The resulting increase in storage costs per bushel were inversely related to storage utilization (figure 11).

At base storage levels, additional storage costs for the 100,000-bushel model totaled 2.51 cents a bushel compared to 2.3 cents for the 400,000-bushel model (appendix table 13).

For a given model, the additional bushels of storage volume required to maintain unit storage costs were greater at lower unit cost levels where the cost-volume curve flattened out (figure 11).

The larger 400,000-bushel elevator model required the greater number of additional bushels of storage utilization in order to maintain the unit storage costs that existed prior to the 30 percent increase in facility values. To illustrate, the larger model required an additional 60,000 bushels to maintain a storage cost of 10 cents a bushel compared to a required additional storage volume of 15,000 bushels for the 100,000-bushel elevator (table 14).

Adding Special Equipment

The addition of any equipment to perform a new function or to do an old job better will result in higher total fixed costs and possibly higher variable costs. The expense of such added equipment may or may not be offset by added income or reduced variable costs. A grain dryer could be expected to produce additional revenue without a volume increase, which would be expected to cover added fixed and variable costs. On the other hand, a new elevator leg or similar equipment would not generally produce additional revenue or necessarily reduce variable costs per bushel except by attracting additional volume. The addition of temperature detecting equipment would increase fixed costs, but it could reduce variable costs such as quality deterioration and the costs associated with turning grain.

By adding new equipment valued at $20,000, fixed costs would be increased around $2,400. Assuming that variable costs remained at current levels, the total cost of handling and merchandising for all elevators would increase 2.4 cents a bushel at 100,000 bushels of volume and two-tenths cent a bushel at 1.2 million bushels of volume (table 15).

In order to maintain the same unit cost under the above conditions the volume would have to be increased. For instance, to maintain a 5-cent level of unit costs, the 100,000-bushel elevator model would have to handle an additional 84,000 bushels, and the 400,000-bushel elevator would have to handle an additional 98,000 bushels (table 14). In order to maintain a 6-cent level, the volume would have to be increased 66,000 bushels for both models. The added volume needed to maintain unit costs becomes less at the "high cost - low volume" points (figure 12).

Figure 11

Relation of Grain Storage Cost to Storage Level for New Concrete Elevator Models Valued at the Current Level and at 30 Percent Higher Value

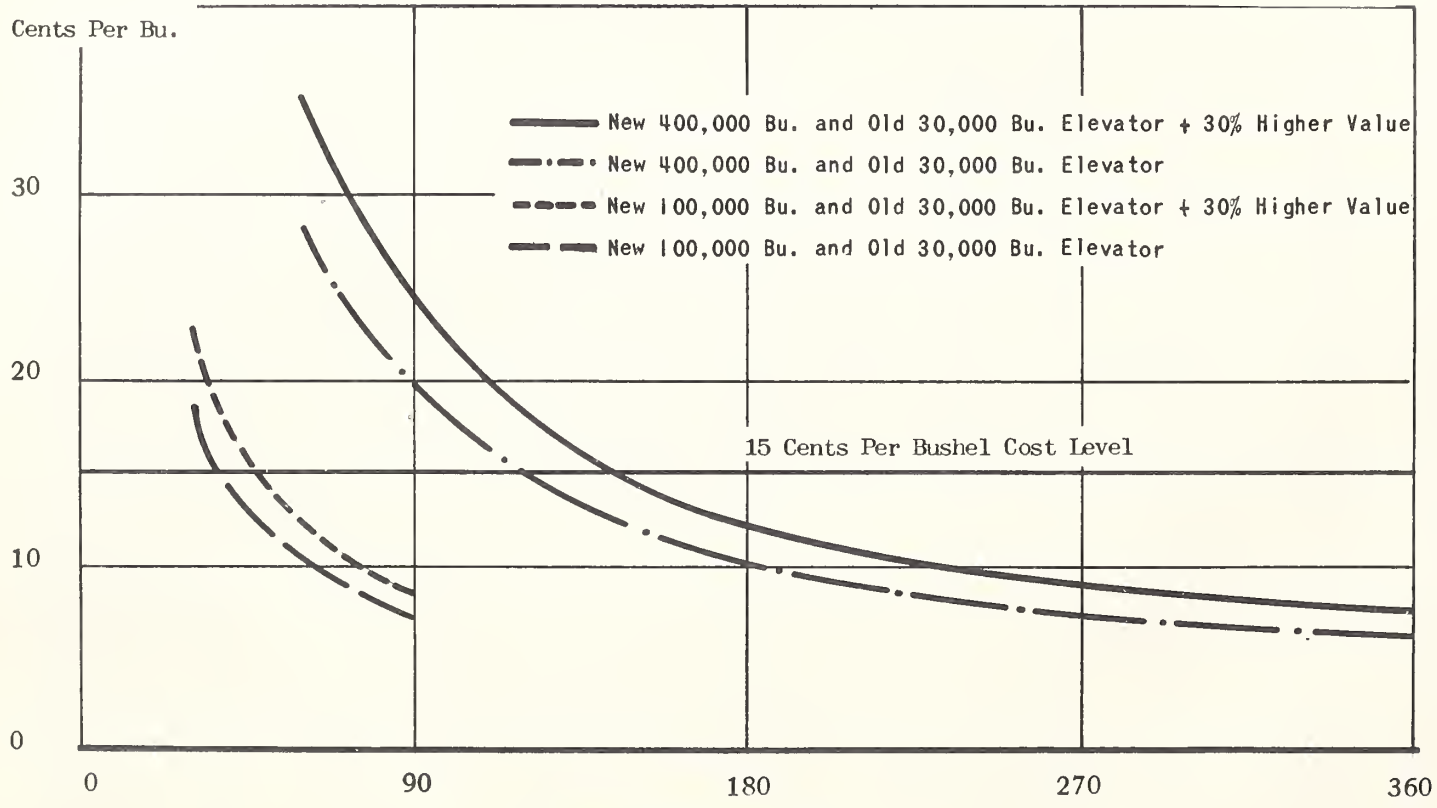


Figure 12

Relation of Merchandising and Handling Costs to Volume Handled, Showing the Effect of $2400 Increased Fixed Costs (of added equipment) Upon Unit Costs, for New Concrete Elevator Models

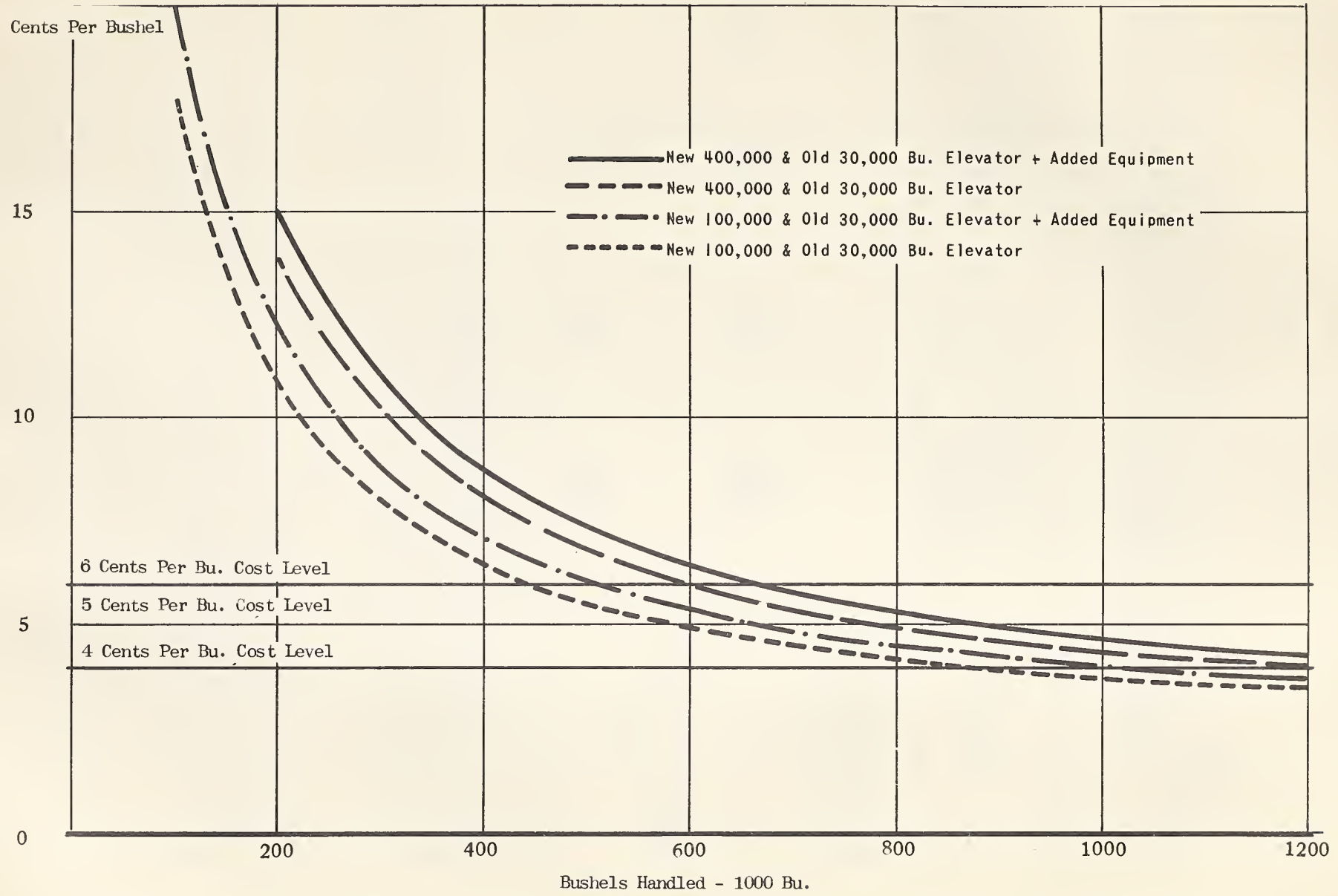


Table 14. Bushels of increased volume required to maintain present unit fixed costs under specified facility situations: (A) When cost of new facilities is 30 percent higher, and (B) when adding special equipment worth $20,000 1/, for selected elevator models.

Unit cost to be maintained:	(A) New facilities at 30 percent higher		(B) Adding $20,000 of special equipment	
	New 100,000-bu. plus old 30,000-bu. elevators	New 400,000-bu. plus old 30,000-bu. elevators	New 100,000-bu. plus old 30,000-bu. elevators	New 400,000-bu. plus old 30,000-bu. elevators
	(bushels)			
Fixed merchandising and handling costs per bushel:				
(cents)				
4	52,000	88,000	137,000	—
5	35,000	66,500	84,000	98,000
6	30,000	50,000	66,000	66,000
Fixed storage costs per bushel:				
(cents)				
10	15,000	60,000	— 2/	—
15	10,000	27,500	—	—

1/ Fixed expenses of special equipment totaled $2,400.

2/ Special equipment was not used to perform the storage function.

Table 15.--Increase in fixed cost per bushel handled caused by adding $20,000 dryer, by volume handled, all elevator models

Volume handled	Increase in unit fixed cost by adding dryer
(bushels)	(cents per bushel)
100,000	2.40
150,000	1.60
200,000	.80
300,000	.60
400,000	.48
500,000	.40
600,000	.40
800,000	.30
1,000,000	.24
1,200,000	.20

CONSIDERATIONS IN CHOOSING TYPE OF ELEVATORS

Most of the cost analysis has emphasized the volume aspect of elevator operations. Actually the type of elevator is an equally important consideration. The models studied have represented three different types of grain facility. Each one performs the same function to different degrees.

Concrete Elevators

Concrete elevators cost more per bushel of capacity but because of a large number of bins they give most flexibility in handling and storing a greater number of different kinds and grades of grain. A new concrete elevator with new equipment should be more "trouble free" and also handle grain at a faster rate. This means better service to patrons, which can be an important factor in increasing volume.

Concrete Tanks

The big advantage of concrete tanks is that they are less costly to build. They utilize the headhouse of another elevator. The additional equipment consists of only the screw conveyors and motors. Each tank comprises one big bin, which doesn't permit storing more than one kind and grade of grain in each concrete tank. A smaller portion of capacity can be utilized than for concrete elevators because empty space equal to capacity of a tank must usually be maintained in order to turn grain. A screw conveyor adds one more place where a "breakdown" can temporarily halt grain handling operations. As a result of these disadvantages, service to patrons may suffer and operating efficiency may be impaired.

Flat Steel Structures

Flat steel storage is considerably cheaper to build than other types of storage. In addition to lower costs other advantages include: (1) The building can be readily adapted to other uses, (2) it doesn't have to be built adjoining a railroad, (3) aerating equipment can be conveniently installed, and (4) temperature detecting equipment can be easily installed.

The flat storage structures are not designed to perform some of the functions ordinarily performed by grain elevators; consequently, the following could prove to be disadvantageous: (1) Grain cannot be turned except by considerable effort and cost, (2) receiving and loading out operations are generally slower and more costly, and (3) shrinkage loss and quality loss may be higher.

Other Factors Affecting the Decision

In a location in which the probable future production is relatively uncertain the risk of capital loss is lessened by erecting low cost facilities with alternative uses. Where prospects for growth in volume are favorable, the higher cost facility appears more likely to be the better investment.

Concrete tank models are dependent upon the proper functioning of this old elevator, whereas, a grain operation with a concrete elevator plus an old elevator has less risk of a shut down since two grain receiving and loading out facilities are provided. Furthermore, additional facilities make it possible to receive or load out more grain at a given time.

Elevators with only old receiving and loading out equipment face the need for earlier replacement of equipment; in some cases, replacement with new equipment cannot be easily done.

Another aspect must be considered when trying to decide what type of facility to add. How will net income be affected? Facilities which provide for a greater number of storage bins permit the elevator operator to keep different qualities and kinds of grain in separate bins; the operator may be able to secure a better price for certain lots of grain if he is able to hold it not co-mingled, or if he is able to do some blending operations which will increase his returns. Thus a comparison of costs alone does not give a complete answer as to what type of facility to add. Each operator has to study his own situation to appraise these possibilities.

APPENDIX

HOW EXPENSE ESTIMATES WERE BUILT UP

For a Given Model:

Case studies were made of actual elevator operations from which information was obtained to budget expenses for the different volumes stored or handled. The following steps were used in building up the budgeted expense items for an elevator model:

1. Obtained an accurate description of the model facilities and capabilities which would typify those used in the Corn Belt.

2. Obtained costs for the new elevator building and equipment.

3. Allocated the intended use of the buildings and equipment between the three functions.

4. Determined the fixed expense rates on new elevator facilities.

5. Calculated the fixed expenses for each function.

6. Determined the base volume handled and base volume stored.

7. Developed the totals for each expense item at base volume levels.

8. Allocated totals for each expense item to the three functions by the most logical method for each particular expense. The allocation to the sideline function remained constant regardless of grain volume.

9. At volumes handled, other than base volume, the variable merchandising and handling expenses were budgeted for each expense item to show the variation in costs. This was done by developing expense graduations by 100,000-bushel changes in handling volume for each variable expense item (appendix table 3). By using these expense graduations, expenses were projected for other volumes handled.

10. At various volumes stored, other than base volumes, the variable storage costs were budgeted to show the effect that changes in the storage level would have upon each variable expense item. To do this, expense graduations by 100,000-bushel changes in storage volume were developed for each expense item.

Between Models:

In developing new facility costs and in budgeting expenses, care was taken to maintain a proper comparative relationship between models.

Expenses for the merchandising and handling function between models were budgeted to change a given dollar amount for each difference of 100,000 bushels in maximum storage capacity. Thus, the difference in expenses between models at the base handling volume were based on both the size of the elevator and volume handled.

Expenses between models for the storage function were budgeted to change a given dollar amount for each difference of 100,000 bushels in the base volume stored. Expenses between models for the sideline function differed only for the power expense which generally declined for the larger elevators.

Appendix table 1. Total annual expense allocated to functions by fixed expense item for each elevator model

Elevator model	Total annual expense	Allocation to functions: Sideline	Merchandising and handling	Storage
	(dollars)			
Depreciation				
Old 30,000-bu. wood	$ 4,300	$ 2,116	$ 2,184	$ -
New 30,000-bu. concrete	6,310	2,116	4,194	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	5,776	2,116	2,996	664
Old 30,000-bu. + four 25,000-bu. concrete tanks	6,800	2,116	3,174	1,510
Old 30,000-bu. + 60,000-bu. concrete	8,070	2,116	4,936	1,018
Old 30,000-bu. + 100,000-bu. concrete	8,690	2,116	5,029	1,545
Old 30,000-bu. + two 55,000-bu. flat steel	6,430	2,116	2,439	1,875
Old 30,000-bu. + 200,000-bu. concrete	10,120	2,116	5,171	2,833
Old 30,000-bu. + 400,000-bu. concrete	14,080	2,116	6,548	5,416
Property Tax				
Old 30,000-bu. wood	1,153	644	509	-
New 30,000-bu. concrete	1,553	644	909	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	1,573	644	708	221
Old 30,000-bu. + four 25,000-bu. concrete tanks	2,028	644	775	609
Old 30,000-bu. + 60,000-bu. concrete	2,216	644	1,193	379
Old 30,000-bu. + 100,000-bu. concrete	2,466	644	1,227	595
Old 30,000-bu. + two 55,000-bu. flat steel	1,756	644	495	617
Old 30,000-bu. + 200,000-bu. concrete	3,128	644	1,294	1,190
Old 30,000-bu. + 400,000-bu. concrete	4,678	644	1,718	2,316
Insurance				
Old 30,000-bu. wood	712	354	358	-
New 30,000-bu. concrete	606	354	252	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	792	354	405	33
Old 30,000-bu. + four 25,000-bu. concrete tanks	892	354	443	95
Old 30,000-bu. + 60,000-bu. concrete	821	354	440	27
Old 30,000-bu. + 100,000-bu. concrete	847	354	450	43
Old 30,000-bu. + two 55,000-bu. flat steel	808	354	389	65
Old 30,000-bu. + 200,000-bu. concrete	912	354	475	83
Old 30,000-bu. + 400,000-bu. concrete	1,054	354	539	161

(continued)

Appendix table 1. (continued)

Elevator model	Total annual expense	Allocation to functions		
		Sideline	Merchandising and handling	Storage
	(dollars)			
Bonds and License				
Old 30,000-bu. wood	10	-	10	-
New 30,000-bu. concrete	10	-	10	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	60	-	10	50
Old 30,000-bu. + four 25,000-bu. concrete tanks	78	-	10	68
Old 30,000-bu. + 60,000-bu. concrete	65	-	10	55
Old 30,000-bu. + 100,000-bu. concrete	78	-	10	68
Old 30,000-bu. + two 55,000-bu. flat steel	80	-	10	70
Old 30,000-bu. + 200,000-bu. concrete	103	-	10	93
Old 30,000-bu. + 400,000-bu. concrete	134	-	10	124
Railroad Lease				
Old 30,000-bu. wood	20	-	20	-
New 30,000-bu. concrete	20	-	20	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	30	-	25	5
Old 30,000-bu. + four 25,000-bu. concrete tanks	40	-	30	10
Old 30,000-bu. + 60,000-bu. concrete	60	-	40	20
Old 30,000-bu. + 100,000-bu. concrete	70	-	45	25
Old 30,000-bu. + two 55,000-bu. flat steel	60	-	40	20
Old 30,000-bu. + 200,000-bu. concrete	110	-	65	45
Old 30,000-bu. + 400,000-bu. concrete	180	-	100	80
Interest on Investment				
Old 30,000-bu. wood	3,620	2,259	1,361	-
New 30,000-bu. concrete	5,460	2,259	3,201	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	4,884	2,259	1,850	775
Old 30,000-bu. + four 25,000-bu. concrete tanks	6,276	2,259	2,195	1,822
Old 30,000-bu. + 60,000-bu. concrete	6,940	2,259	3,531	1,150
Old 30,000-bu. + 100,000-bu. concrete	7,692	2,259	3,685	1,748
Old 30,000-bu. + two 55,000-bu. flat steel	5,112	2,259	1,125	1,728
Old 30,000-bu. + 200,000-bu. concrete	9,700	2,259	4,099	3,342
Old 30,000-bu. + 400,000-bu. concrete	14,436	2,259	5,812	6,365

Appendix table 2. Total annual expense allocated to functions, by variable expense item, at base volumes handled and stored 1/, for each elevator model

Elevator model	Total annual expense	Allocation to functions		
		Sideline	Merchandising and handling	Storage
	(dollars)			
Personnel Expense				
Old 30,000-bu. wood	$ 11,749	$ 3,965	$ 7,784	$ -
New 30,000-bu. concrete	11,749	3,965	7,784	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	13,840	3,965	9,139	736
Old 30,000-bu. + four 25,000-bu. concrete tanks	15,189	3,965	10,379	845
Old 30,000-bu. + 60,000-bu. concrete	16,179	3,965	11,442	772
Old 30,000-bu. + 100,000-bu. concrete	18,421	3,965	13,611	845
Old 30,000-bu. + two 55,000-bu. flat steel	14,465	3,965	9,600	900
Old 30,000-bu. + 200,000-bu. concrete	20,940	3,965	15,965	1,010
Old 30,000-bu. + 400,000-bu. concrete	25,380	3,965	20,076	1,339
Advertising				
Old 30,000-bu. wood	200	200	-	-
New 30,000-bu. concrete	200	200	-	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	200	200	-	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	200	200	-	-
Old 30,000-bu. + 60,000-bu. concrete	200	200	-	-
Old 30,000-bu. + 100,000-bu. concrete	200	200	-	-
Old 30,000-bu. + two 55,000-bu. flat steel	200	200	-	-
Old 30,000-bu. + 200,000-bu. concrete	200	200	-	-
Old 30,000-bu. + 400,000-bu. concrete	200	200	-	-
Auditing				
Old 30,000-bu. wood	275	75	200	-
New 30,000-bu. concrete	275	75	200	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	335	75	234	26
Old 30,000-bu. + four 25,000-bu. concrete tanks	374	75	269	30
Old 30,000-bu. + 60,000-bu. concrete	404	75	296	33
Old 30,000-bu. + 100,000-bu. concrete	441	75	329	37
Old 30,000-bu. + two 55,000-bu. flat steel	342	75	240	27
Old 30,000-bu. + 200,000-bu. concrete	506	75	388	43
Old 30,000-bu. + 400,000-bu. concrete	600	75	472	53
Bad Accounts				
Old 30,000-bu. wood	200	200	-	-
New 30,000-bu. concrete	200	200	-	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	200	200	-	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	200	200	-	-
Old 30,000-bu. + 60,000-bu. concrete	200	200	-	-
Old 30,000-bu. + 100,000-bu. concrete	200	200	-	-
Old 30,000-bu. + two 55,000-bu. flat steel	200	200	-	-
Old 30,000-bu. + 200,000-bu. concrete	200	200	-	-
Old 30,000-bu. + 400,000-bu. concrete	200	200	-	-

1/ See page for definition of base volumes handled and stored.

(continued)

Appendix table 2. (continued)

Elevator model	Total annual expense	Allocation to functions: Sideline	Merchandising and handling	Storage
		(dollars)		
Directors' Fees				
Old 30,000-bu. wood	300	50	250	-
New 30,000-bu. concrete	300	50	250	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	300	50	225	25
Old 30,000-bu. + four 25,000-bu. concrete tanks	300	50	225	25
Old 30,000-bu. + 60,000-bu. concrete	300	50	225	25
Old 30,000-bu. + 100,000-bu. concrete	300	50	225	25
Old 30,000-bu. + two 55,000-bu. flat steel	300	50	225	25
Old 30,000-bu. + 200,000-bu. concrete	300	50	225	25
Old 30,000-bu. + 400,000-bu. concrete	300	50	225	25
Donations				
Old 30,000-bu. wood	90	15	75	-
New 30,000-bu. concrete	90	15	75	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	115	15	90	10
Old 30,000-bu. + four 25,000-bu. concrete tanks	130	15	103	12
Old 30,000-bu. + 60,000-bu. concrete	145	15	117	13
Old 30,000-bu. + 100,000-bu. concrete	160	15	130	15
Old 30,000-bu. + two 55,000-bu. flat steel	115	15	90	10
Old 30,000-bu. + 200,000-bu. concrete	190	15	157	18
Old 30,000-bu. + 400,000-bu. concrete	220	15	184	21
Dues and Subscriptions				
Old 30,000-bu. wood	50	15	35	-
New 30,000-bu. concrete	50	15	35	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	60	15	45	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	70	15	55	-
Old 30,000-bu. + 60,000-bu. concrete	80	15	65	-
Old 30,000-bu. + 100,000-bu. concrete	90	15	75	-
Old 30,000-bu. + two 55,000-bu. flat steel	60	15	45	-
Old 30,000-bu. + 200,000-bu. concrete	110	15	95	-
Old 30,000-bu. + 400,000-bu. concrete	130	15	115	-
Heat				
Old 30,000-bu. wood	97	15	82	-
New 30,000-bu. concrete	97	15	82	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	98	15	83	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	101	15	86	-
Old 30,000-bu. + 60,000-bu. concrete	100	15	85	-
Old 30,000-bu. + 100,000-bu. concrete	102	15	87	-
Old 30,000-bu. + two 55,000-bu. flat steel	98	15	83	-
Old 30,000-bu. + 200,000-bu. concrete	107	15	92	-
Old 30,000-bu. + 400,000-bu. concrete	115	15	100	-

(continued)

Appendix table 2. (continued)

Elevator model	Total annual expense	Allocation to functions: Sideline	Merchandising and handling	Storage
		(dollars)		
Insect Control				
Old 30,000-bu. wood	35	-	35	-
New 30,000-bu. concrete	35	-	35	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	135	-	54	81
Old 30,000-bu. + four 25,000-bu. concrete tanks	314	-	71	243
Old 30,000-bu. + 60,000-bu. concrete	224	-	89	135
Old 30,000-bu. + 100,000-bu. concrete	349	-	106	243
Old 30,000-bu. + two 55,000-bu. flat steel	378	-	54	324
Old 30,000-bu. + 200,000-bu. concrete	628	-	142	486
Old 30,000-bu. + 400,000-bu. concrete	1,149	-	177	972
Insurance on Merchandise				
Old 30,000-bu. wood	288	174	114	-
New 30,000-bu. concrete	203	174	29	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	381	174	117	90
Old 30,000-bu. + four 25,000-bu. concrete tanks	574	174	130	270
Old 30,000-bu. + 60,000-bu. concrete	306	174	67	65
Old 30,000-bu. + 100,000-bu. concrete	362	174	71	117
Old 30,000-bu. + two 55,000-bu. flat steel	555	174	117	264
Old 30,000-bu. + 200,000-bu. concrete	488	174	80	234
Old 30,000-bu. + 400,000-bu. concrete	741	174	99	468
Interest on Seasonal Capital				
Old 30,000-bu. wood	53	20	33	-
New 30,000-bu. concrete	53	20	33	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	70	20	50	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	87	20	67	-
Old 30,000-bu. + 60,000-bu. concrete	103	20	83	-
Old 30,000-bu. + 100,000-bu. concrete	120	20	100	-
Old 30,000-bu. + two 55,000-bu. flat steel	53	20	33	-
Old 30,000-bu. + 200,000-bu. concrete	153	20	133	-
Old 30,000-bu. + 400,000-bu. concrete	187	20	167	-
Legal				
Old 30,000-bu. wood	50	10	40	-
New 30,000-bu. concrete	50	10	40	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	55	10	45	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	60	10	50	-
Old 30,000-bu. + 60,000-bu. concrete	65	10	55	-
Old 30,000-bu. + 100,000-bu. concrete	70	10	60	-
Old 30,000-bu. + two 55,000-bu. flat steel	55	10	45	-
Old 30,000-bu. + 200,000-bu. concrete	80	10	70	-
Old 30,000-bu. + 400,000-bu. concrete	90	10	80	-

(continued)

Appendix table 2. (continued)

Elevator model	Total annual expense	Allocation to functions		
		Sideline	Merchandising and handling	Storage
	(dollars)			
Lights				
Old 30,000-bu. wood	61	7	54	-
New 30,000-bu. concrete	61	7	54	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	67	7	59	1
Old 30,000-bu. + four 25,000-bu. concrete tanks	80	7	70	3
Old 30,000-bu. + 60,000-bu. concrete	77	7	68	2
Old 30,000-bu. + 100,000-bu. concrete	78	7	68	3
Old 30,000-bu. + two 55,000-bu. flat steel	80	7	69	4
Old 30,000-bu. + 200,000-bu. concrete	92	7	79	6
Old 30,000-bu. + 400,000-bu. concrete	124	7	104	13
Meetings and Member Relations				
Old 30,000-bu. wood	180	30	150	-
New 30,000-bu. concrete	180	30	150	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	200	30	170	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	220	30	190	-
Old 30,000-bu. + 60,000-bu. concrete	240	30	210	-
Old 30,000-bu. + 100,000-bu. concrete	260	30	230	-
Old 30,000-bu. + two 55,000-bu. flat steel	200	30	170	-
Old 30,000-bu. + 200,000-bu. concrete	300	30	270	-
Old 30,000-bu. + 400,000-bu. concrete	340	30	310	-
Miscellaneous Expenses				
Old 30,000-bu. wood	100	50	50	-
New 30,000-bu. concrete	100	50	50	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	110	50	60	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	120	50	70	-
Old 30,000-bu. + 60,000-bu. concrete	130	50	80	-
Old 30,000-bu. + 100,000-bu. concrete	140	50	90	-
Old 30,000-bu. + two 55,000-bu. flat steel	110	50	60	-
Old 30,000-bu. + 200,000-bu. concrete	160	50	110	-
Old 30,000-bu. + 400,000-bu. concrete	180	50	130	-
Office Supplies				
Old 30,000-bu. wood	285	150	135	-
New 30,000-bu. concrete	285	150	135	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	325	150	157	18
Old 30,000-bu. + four 25,000-bu. concrete tanks	350	150	180	20
Old 30,000-bu. + 60,000-bu. concrete	375	150	205	20
Old 30,000-bu. + 100,000-bu. concrete	400	150	225	25
Old 30,000-bu. + two 55,000-bu. flat steel	325	150	157	18
Old 30,000-bu. + 200,000-bu. concrete	450	150	270	30
Old 30,000-bu. + 400,000-bu. concrete	500	150	315	35

(continued)

Appendix table 2. (continued)

Elevator model	Total annual expense	Allocation to functions		
		Sideline	Merchandising and handling	Storage
	(dollars)			
Plant Supplies				
Old 30,000-bu. wood	145	80	65	-
New 30,000-bu. concrete	130	80	50	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	200	80	72	48
Old 30,000-bu. + four 25,000-bu. concrete tanks	220	80	77	63
Old 30,000-bu. + 60,000-bu. concrete	200	80	102	18
Old 30,000-bu. + 100,000-bu. concrete	220	80	112	28
Old 30,000-bu. + two 55,000-bu. flat steel	200	80	48	72
Old 30,000-bu. + 200,000-bu. concrete	280	80	150	50
Old 30,000-bu. + 400,000-bu. concrete	320	80	168	72
Power				
Old 30,000-bu. wood	840	516	324	-
New 30,000-bu. concrete	840	516	324	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	876	468	408	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	924	432	492	-
Old 30,000-bu. + 60,000-bu. concrete	948	432	516	-
Old 30,000-bu. + 100,000-bu. concrete	984	456	528	-
Old 30,000-bu. + two 55,000-bu. flat steel	912	576	336	-
Old 30,000-bu. + 200,000-bu. concrete	1,080	468	612	-
Old 30,000-bu. + 400,000-bu. concrete	1,188	336	852	-
Repairs and Maintenance				
Old 30,000-bu. wood	1,000	200	800	-
New 30,000-bu. concrete	400	200	200	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	1,087	200	856	31
Old 30,000-bu. + four 25,000-bu. concrete tanks	1,144	200	869	75
Old 30,000-bu. + 60,000-bu. concrete	863	200	603	60
Old 30,000-bu. + 100,000-bu. concrete	961	200	656	105
Old 30,000-bu. + two 55,000-bu. flat steel	1,178	200	889	89
Old 30,000-bu. + 200,000-bu. concrete	1,200	200	808	192
Old 30,000-bu. + 400,000-bu. concrete	1,500	200	922	378
Scale Expense				
Old 30,000-bu. wood	50	5	45	-
New 30,000-bu. concrete	50	5	45	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	57	5	52	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	64	5	59	-
Old 30,000-bu. + 60,000-bu. concrete	68	5	63	-
Old 30,000-bu. + 100,000-bu. concrete	78	5	73	-
Old 30,000-bu. + two 55,000-bu. flat steel	57	5	52	-
Old 30,000-bu. + 200,000-bu. concrete	92	5	87	-
Old 30,000-bu. + 400,000-bu. concrete	106	5	101	-

(continued)

Appendix table 2. (continued)

Elevator model	Total annual expense	Allocation to functions: Sideline	Merchandising and handling	Storage
	(dollars)			
Shrinkage and Quality Deterioration				
Old 30,000-bu. wood	1,000	-	1,000	-
New 30,000-bu. concrete	1,000	-	1,000	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	1,613	-	1,500	113
Old 30,000-bu. + four 25,000-bu. concrete tanks	2,338	-	2,000	338
Old 30,000-bu. + 60,000-bu. concrete	2,688	-	2,500	188
Old 30,000-bu. + 100,000-bu. concrete	3,338	-	3,000	338
Old 30,000-bu. + two 55,000-bu. flat steel	2,700	-	1,500	1,200
Old 30,000-bu. + 200,000-bu. concrete	4,675	-	4,000	675
Old 30,000-bu. + 400,000-bu. concrete	6,350	-	5,000	1,350
Telephone and Telegraph				
Old 30,000-bu. wood	200	24	176	-
New 30,000-bu. concrete	200	24	176	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	225	24	201	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	250	24	226	-
Old 30,000-bu. + 60,000-bu. concrete	275	24	251	-
Old 30,000-bu. + 100,000-bu. concrete	300	24	276	-
Old 30,000-bu. + two 55,000-bu. flat steel	225	24	201	-
Old 30,000-bu. + 200,000-bu. concrete	350	24	326	-
Old 30,000-bu. + 400,000-bu. concrete	400	24	376	-
Travel				
Old 30,000-bu. wood	80	20	60	-
New 30,000-bu. concrete	80	20	60	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	90	20	70	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	100	20	80	-
Old 30,000-bu. + 60,000-bu. concrete	110	20	90	-
Old 30,000-bu. + 100,000-bu. concrete	120	20	100	-
Old 30,000-bu. + two 55,000-bu. flat steel	90	20	70	-
Old 30,000-bu. + 200,000-bu. concrete	140	20	120	-
Old 30,000-bu. + 400,000-bu. concrete	160	20	140	-
Water				
Old 30,000-bu. wood	24	5	19	-
New 30,000-bu. concrete	24	5	19	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	25	5	20	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	26	5	21	-
Old 30,000-bu. + 60,000-bu. concrete	27	5	22	-
Old 30,000-bu. + 100,000-bu. concrete	28	5	23	-
Old 30,000-bu. + two 55,000-bu. flat steel	25	5	20	-
Old 30,000-bu. + 200,000-bu. concrete	30	5	25	-
Old 30,000-bu. + 400,000-bu. concrete	32	5	27	-

Appendix table 3.—Ratios used in budgeting variable expenses for grain functions 1/between models and within models at various volumes and capacities

Expense item	Between models: Expense change per 100,000-bu. change in: Maximum storage capacity	Between models: Expense change per 100,000-bu. change in: Base storage volume	Between models: Expense change per 100,000-bu. change in: Base handling volume	Within models: Expense change per 100,000-bu. change in: Base storage volume	Within models: Expense change per 100,000-bu. change in: Base handling volume	Method of allocation between grain functions at base volumes
	(dollars)					(percent)
Personnel 2/	-	-	-	-	-	-
Advertising	(Same for all models)			(Same for all volumes)		None
Auditing	$10.00	-	$33.00	$ 5.00	$20.00	10 to storage and 90 to merchandising and handling
Bad accounts	(Same for all models)			(Same for all volumes)		None
Directors' fees	(Same for all models)			(Same for all volumes)		10 to storage and 90 to merchandising and handling
Donations	-	-	15.00	-	10.00	10 to storage and 90 to merchandising and handling
Dues and subscriptions	-	-	10.00	-	5.00	100 to merchandising and handling
Heat	5.00	-	-	(Same for all volumes)		100 to merchandising and handling
Insect control	-	200.00	20.00	200.00	20.00	Direct use
Insurance on merchandise 3/	-	-	-	-	-	-
Interest on seasonal capital	-	-	17.00	-	17.00	100 to merchandising and handling
Legal	-	-	5.00	-	5.00	100 to merchandising and handling
Lights	20.00	-	2.00	8.00	2.00	3/
Meetings and member relations	-	-	20.00	-	20.00	100 to merchandising and handling
Miscellaneous expenses	-	-	5.00	-	5.00	100 to merchandising and handling
Office supplies	-	-	25.00	5.00	15.00	10 to storage and 90 to merchandising and handling
Plant supplies 3/	-	-	-	6.00	4.00	Same as for equipment fixed expense
Power 3/	-	-	-	-	-	100 to merchandising and handling (see text)
Repairs and maintenance 3/	-	-	-	20.00	40.00	Same as used for depreciation
Scale expense	-	-	7.00	-	7.00	100 to merchandising and handling
Shrinkage and quality loss 3/	-	-	-	-	-	-
Telephone and telegraph	-	-	25.00	-	25.00	100 to merchandising and handling
Travel	-	-	10.00	-	8.00	100 to merchandising and handling
Water	-	-	1.00	-	1.00	100 to merchandising and handling

1/ The expense amounts budgeted to the sideline function would not be affected by these ratios since they would be a fixed amount for each expense item.
2/ Personnel expenses were budgeted and allocated to functions separately for each employee. See discussion in text.
3/ Special calculation—see discussion in text.

Appendix table 4. Total annual salaries and wages[1] of each employee for each elevator model at base volumes handled and stored[2]

Elevator model	Employee position						
	Manager	Bookkeeper	1st elevator man	Warehouse man	2nd elevator man	Extra	Total
(1,000 bu.)	(dollars)						
Old 30 wood	$ 4,500	$ —	$ 3,165	$ 3,350	$ —	$ 250	$ 11,265
New 30 concrete	4,500	—	3,165	3,350	—	250	11,265
Old 30 + two 20 concrete tanks	4,900	1,167	3,290	3,419	—	500	13,276
Old 30 + four 25 concrete tanks	5,420	1,453	3,445	3,511	—	750	14,579
Old 30 + 60 concrete	5,600	1,877	3,515	3,539	—	1,000	15,531
Old 30 + 100 concrete	6,040	3,380	3,650	3,615	—	1,000	17,685
Old 30 + two 55 flat steel	5,140	1,185	3,350	3,465	—	740	13,880
Old 30 + 200 concrete	7,000	3,648	3,940	3,783	—	1,750	20,121
Old 30 + 400 concrete	8,320	3,983	4,320	4,018	3,515	250	24,406

1/ Does not include F.I.C.A. or Workmen's Compensation Insurance

2/ See page 10 for definition of base volumes handled and stored.

Appendix table 5. Total fixed expense allocated to functions, for each elevator model

Elevator model	Total annual fixed expense	Allocation to functions		
		Sideline	Merchandising and handling	Storage
	(dollars)			
Old 30,000-bu. wood	$ 9,815	$ 5,373	$ 4,442	$ —
New 30,000-bu. concrete	13,959	5,373	8,586	—
Old 30,000-bu. + two 20,000-bu. concrete tanks	13,115	5,373	5,994	1,748
Old 30,000-bu. + four 25,000-bu. concrete tanks	16,114	5,373	6,627	4,114
Old 30,000-bu. + 60,000-bu. concrete	18,172	5,373	10,150	2,649
Old 30,000-bu. + 100,000-bu. concrete	19,843	5,373	10,446	4,024
Old 30,000-bu. + two 55,000-bu. flat steel	14,114	5,373	4,446	4,295
Old 30,000-bu. + 200,000-bu. concrete	24,073	5,373	11,114	7,586
Old 30,000-bu. + 400,000-bu. concrete	34,562	5,373	14,727	14,462

Appendix table 6.—Total fixed expense per bushel stored, for the storage function, at various storage volumes, for each elevator model

Elevator model	Volume stored (1,000 bu.)							
	15	30	45	60	90	180	270	360
	(cents per bushel)							
Old 30,000-bu. wood	-	-	-	-	-	-	-	-
New 30,000-bu. concrete	-	-	-	-	-	-	-	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	1/11.65	5.83	-	-	-	-	-	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	-	13.71	1/9.14	6.86	4.57	-	-	-
Old 30,000-bu. + 60,000-bu. concrete	17.66	2/8.83	5.89	-	-	-	-	-
Old 30,000-bu. + 100,000-bu. concrete	-	13.41	1/8.94	6.71	4.47	-	-	-
Old 30,000-bu. + two 55,000-bu. flat steel	-	14.32	9.54	1/7.16	4.77	-	-	-
Old 30,000-bu. + 200,000-bu. concrete	-	-	16.86	12.64	1/8.43	4.21	-	-
Old 30,000-bu. + 400,000-bu. concrete	-	-	-	24.10	16.07	1/8.03	5.36	4.02

1/ Expenses at "base" storage volume
2/ At the "base" storage volume of 25,000 bushels, the total fixed storage expense per bushel is 10.6 cents.

Appendix table 7.—Total fixed expense per bushel handled for merchandising and handling function, at various volumes handled, for each elevator model

Elevator model	Volume handled (1,000 bu.)									
	100	150	200	300	400	500	600	800	1,000	1,200
	(cents per bushel)									
Old 30,000-bu. wood	4.44	2.96	1/2.22	1.48	1.11	.89	-	-	-	-
New 30,000-bu. concrete	8.59	5.72	1/4.29	2.86	2.15	1.72	-	-	-	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	5.99	4.00	3.00	1/2.00	1.50	1.20	1.00	.75	-	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	6.63	4.42	3.31	2.21	1/1.66	1.33	1.10	.83	.66	.55
Old 30,000-bu. + 60,000-bu. concrete	10.15	6.77	5.08	3.38	2.54	1/2.03	1.69	1.27	1.02	-
Old 30,000-bu. + 100,000-bu. concrete	10.45	6.96	5.22	3.48	2.61	2.09	1/1.74	1.31	1.04	.87
Old 30,000-bu. + two 55,000-bu. flat steel	4.45	2.96	2.22	1/1.48	1.11	.89	.74	.56	-	-
Old 30,000-bu. + 200,000-bu. concrete	-	-	5.56	3.70	2.78	2.22	1.85	1/1.39	1.11	.93
Old 30,000-bu. + 400,000-bu. concrete	-	-	7.36	4.91	3.68	2.95	2.45	1.84	1/1.47	1.23

1/ Expenses at "base" merchandising and handling volume.

Appendix table 8.—Total annual variable expense 1/ and expense per bushel handled, for merchandising and handling function, at various volumes handled, for each elevator model

Elevator model	Volume handled (1,000 bu.)									
	100	150	200	300	400	500	600	800	1,000	1,200
	(dollars)									
Old 30,000-bu. wood	7,698	9,769	2/11,526	14,161	15,873	17,737	-	-	-	-
New 30,000-bu. concrete	6.997	9,068	2/10,826	13,461	15,173	17,037	-	-	-	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	7,216	9,287	11,065	2/13,707	15,423	17,286	19,984	23,349	-	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	7,511	9,581	11,403	14,063	2/15,769	17,649	20,366	23,682	28,103	31,439
Old 30,000-bu. + 60,000-bu. concrete	7,131	9,202	11,000	13,652	15,369	2/17,234	19,939	23,256	27,621	-
Old 30,000-bu. + 100,000-bu. concrete	7,309	9,379	11,205	13,868	15,587	17,454	2/20,175	23,488	27,879	31,215
Old 30,000-bu. + two 55,000-bu. flat steel	7,297	9,452	11,442	14,104	2/15,823	17,692	21,212	23,823	-	-
Old 30,000-bu. + 200,000-bu. concrete	-	-	11,852	14,541	16,264	18,141	20,888	2/24,204	28,652	31,933
Old 30,000-bu. + 400,000-bu. concrete	-	-	12,999	15,751	17,487	19,380	22,186	25,503	2/30,140	33,393
	(cents per bushel)									
Old 30,000-bu. wood	7.70	6.51	2/5.76	4.72	3.97	3.55	-	-	-	-
New 30,000-bu. concrete	7.00	6.05	2/5.41	4.49	3.79	3.41	-	-	-	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	7.22	6.19	5.53	2/4.57	3.86	3.46	3.33	2.92	-	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	7.51	6.39	5.70	4.69	2/3.94	3.53	3.39	2.96	2.81	2.62
Old 30,000-bu. + 60,000-bu. concrete	7.13	6.13	5.50	4.55	3.84	2/3.45	3.32	2.91	2.76	-
Old 30,000-bu. + 100,000-bu. concrete	7.31	6.25	5.60	4.62	3.90	3.49	2/3.36	2.94	2.79	2.60
Old 30,000-bu. + two 55,000-bu. flat steel	7.30	6.30	5.72	4.70	2/3.96	3.54	3.54	2.98	-	-
Old 30,000-bu. + 200,000-bu. concrete	-	-	5.93	4.85	4.07	3.63	3.48	2/3.03	2.87	2.66
Old 30,000-bu. + 400,000-bu. concrete	-	-	6.50	5.25	4.37	3.88	3.70	3.19	2/3.01	2.78

1/ Includes personnel expense, shrinkage and quality deterioration, and all other variable expense.
2/ Expenses at "base" merchandising and handling volume.

Appendix table 9. Total annual variable expense[1] and expense per bushel stored, for the storage function, at various storage volumes, for each elevator model

Elevator model	Volume stored (1,000 bu.)							
	15	30	45	60	90	180	270	360
(1,000 bu.)	(dollars)							
Old 30 wood	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
New 30 concrete	-	-	-	-	-	-	-	-
Old 30 + two 20 concrete tanks	1,179[1]	1,505	-	-	-	-	-	-
Old 30 + four 25 concrete tanks	-	1,595[2]	1,924[1]	2,252	2,905	-	-	-
Old 30 + 60 concrete	1,150	1,423[2]	1,699[1]	-	-	-	-	-
Old 30 + 100 concrete	-	1,503	1,781[1]	2,058[1]	2,609	-	-	-
Old 30 + two 55 flat steel	-	1,953	2,443	2,933[1]	3,914[1]	-	-	-
Old 30 + 200 concrete	-	-	1,940	2,218	2,769[1]	4,422[1]	-	-
Old 30 + 400 concrete	-	-	-	2,521	3,072	4,726[1]	6,380	8,033
	(cents per bushel)							
Old 30 wood	-	-	-	-	-	-	-	-
New 30 concrete	-	-	-	-	-	-	-	-
Old 30 + two 20 concrete tanks	7.86[1]	5.02	-	-	-	-	-	-
Old 30 + four 25 concrete tanks	-	5.32[2]	4.28[1]	3.75	3.23	-	-	-
Old 30 + 60 concrete	7.67	4.74[2]	3.78[1]	-	-	-	-	-
Old 30 + 100 concrete	-	5.01	3.96[1]	3.43[1]	2.90	-	-	-
Old 30 + two 55 flat steel	-	6.51	5.43	4.89[1]	4.35[1]	-	-	-
Old 30 + 200 concrete	-	-	4.31	3.70	3.08[1]	2.46[1]	-	-
Old 30 + 400 concrete	-	-	-	4.20	3.41	2.63[1]	2.36	2.23

1/ Includes personnel expense, shrinkage and quality deterioration, and all other variable expenses.

2/ Expenses at "base" storage volume.

3/ At the "base" storage volume of 25,000 bushels, the total storage expense is $1,331, or 5.32 cents a bushel.

Appendix table 10.—Total annual expense and expense per bushel handled for merchandising and handling functions, at various volumes handled, for each elevator model

Elevator model	Volume handled (1,000 bushels)									
	100	150	200	300	400	500	600	800	1,000	1,200
	(dollars)									
Old 30,000-bu. wood	12,140	14,211	1/15,968	18,603	20,315	22,179	-	-	-	-
New 30,000-bu concrete	15,583	17,654	1/19,412	22,047	23,759	25,623	-	-	-	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	13,210	15,281	17,059	1/19,701	21,417	23,280	25,978	29,343	-	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	14,138	16,208	18,030	20,690	1/22,396	24,276	26,993	30,309	34,730	38,066
Old 30,000-bu. + 60,000-bu. concrete	17,281	19,352	21,150	23,802	25,519	1/27,384	30,089	33,406	37,771	-
Old 30,000-bu. + 100,000-bu. concrete	17,755	19,825	21,651	24,314	26,033	27,900	1/30,621	33,934	38,325	41,661
Old 30,000-bu. + two 55,000-bu. flat steel	11,743	13,898	15,888	1/18,550	20,269	22,138	25,658	28,269	-	-
Old 30,000-bu. + 200,000-bu. concrete	-	-	22,966	25,655	27,378	29,255	32,002	1/35,318	39,766	43,047
Old 30,000-bu. + 400,000-bu. concrete	-	-	27,726	30,478	32,214	34,107	36,913	40,230	1/44,867	48,120
	(cents per bushel)									
Old 30,000-bu. wood	12.14	9.47	1/7.98	6.20	5.08	4.44	-	-	-	-
New 30,000-bu. concrete	15.58	11.77	1/9.71	7.35	5.94	5.12	-	-	-	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	13.21	10.19	8.53	1/6.57	5.35	4.66	4.33	3.67	-	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	14.14	10.81	9.02	6.90	1/5.60	4.86	4.50	3.79	3.47	3.17
Old 30,000-bu. + 60,000-bu. concrete	17.28	12.90	10.58	7.93	6.38	1/5.48	5.01	4.18	3.78	-
Old 30,000-bu. + 100,000-bu. concrete	17.76	13.22	10.83	8.10	6.51	5.58	1/5.10	4.24	3.83	3.47
Old 30,000-bu. + two 55,000-bu. flat steel	11.74	9.27	7.94	1/6.18	5.07	4.43	4.28	3.53	-	-
Old 30,000-bu. + 200,000-bu. concrete	-	-	11.48	8.55	6.84	5.85	5.33	1/4.41	3.98	3.59
Old 30,000-bu. + 400,000-bu. concrete	-	-	13.86	10.16	8.05	6.82	6.15	5.03	1/4.49	4.01

1/ Expenses at "base" merchandising and handling volume

Appendix table 11.—Total annual expense and expense per bushel stored, for the storage function, at various storage volumes, for each elevator model

Elevator model	Volume stored (1,000 bu.)							
	15	30	45	60	90	180	270	360
	(dollars)							
Old 30,000-bu. wood 1/	-	-	-	-	-	-	-	-
New 30,000-bu. concrete 1/	-	-	-	-	-	-	-	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	2/2,927	3,253	-	-	-	-	-	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	-	5,709	2/6,038	6,366	7,019	-	-	-
Old 30,000-bu. + 60,000-bu. concrete	3,799	3/4,072	4,348	-	-	-	-	-
Old 30,000-bu. + 100,000-bu. concrete	-	5,527	2/5,805	6,082	6,633	-	-	-
Old 30,000-bu. + two 55,000-bu. flat steel	-	6,248	6,738	2/7,228	8,209	-	-	-
Old 30,000-bu. + 200,000-bu. concrete	-	-	9,526	9,804	2/10,355	12,008	-	-
Old 30,000-bu. + 400,000-bu. concrete	-	-	-	16,983	17,534	2/19,188	20,842	22,495
	(cents per bushel)							
Old 30,000-bu. wood 1/	-	-	-	-	-	-	-	-
New 30,000-bu. concrete 1/	-	-	-	-	-	-	-	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	2/19.51	10.84	-	-	-	-	-	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	-	19.03	2/13.42	10.61	7.80	-	-	-
Old 30,000-bu. + 60,000-bu. concrete	25.33	3/13.57	9.66	-	-	-	-	-
Old 30,000-bu. + 100,000-bu. concrete	-	18.42	2/12.90	10.14	7.37	-	-	-
Old 30,000-bu. + two 55,000-bu. flat steel	-	20.83	14.97	2/12.05	9.12	-	-	-
Old 30,000-bu. + 200,000-bu. concrete	-	-	21.17	16.34	2/11.51	6.67	-	-
Old 30,000-bu. + 400,000-bu concrete	-	-	-	28.31	19.48	2/10.66	7.72	6.25

1/ It was assumed that none of the capacity of the 30,000-bushel elevators was used for storing grain over 30 days; thus, all grain expense was charged to the merchandising and handling function for these two elevator models.
2/ Expenses at "base" storage volume.
3/ At "base" storage volume of 25,000 bu. total storage expense is $3,980 or 15.9 cents per bu.

Appendix table 12. Increase in unit costs of merchandising and handling resulting from 30 percent increase in new grain facilities, at various volumes handled, for selected elevator models

Elevator model	Volume handled (1,000 bu.)									
	100	150	200	300	400	500	600	800	1,000	1,200
(1,000 bu.)	(cents per bushel)									
At current costs:										
100 concrete + old 30	17.76	13.22	10.83	8.10	6.51	5.58	5.10 1/	4.24	3.93 1/	3.47
400 concrete + old 30	—	—	13.83	10.16	8.05	6.82	6.15	5.03	4.49 1/	4.01
At current costs plus 30 percent:										
100 concrete + old 30	20.15	14.81	12.02	8.90	7.11	6.05	5.50 1/	4.54	4.07 1/	3.67
400 concrete + old 30	—	—	15.55	11.28	8.89	7.50	6.71	5.45	4.82 1/	4.29
Increase in unit costs:										
100 concrete + old 30	2.39	1.59	1.19	.80	.60	.47	.40 1/	.30	.24 1/	.20
400 concrete + old 30	—	—	1.69	1.12	.84	.68	.56	.42	.33 1/	.28

1/ Expenses at "base" merchandising and handling volume.

Appendix table 13. Increase in unit storage costs resulting from 30 percent increase in new grain facilities, at various volumes, for selected elevator models.

Elevator model	Volume stored (1,000 bu.)							
	15	30	45	60	90	180	270	360
(1,000 bu.)	(cents per bushel)							
At current costs:								
100 concrete + old 30	—	18.42	12.90 1/	10.14	7.37	— 1/	—	—
400 concrete + old 30	—	—	—	28.31	19.48	10.66 1/	7.72	6.25
At current costs plus 30 percent:								
100 concrete + old 30	—	22.19	15.41 1/	12.02	8.62	— 1/	—	—
400 concrete + old 30	—	—	—	35.20	24.07	12.96 1/	9.25	7.40
Increase in unit costs:								
100 concrete + old 30	—	3.77	2.51 1/	1.88	1.25	— 1/	—	—
400 concrete + old 30	—	—	—	6.89	4.59	2.30 1/	1.53	1.15

1/ Expenses at "base" storage volume.

Appendix table 14.—Total annual expense after adding $20,000 1/ of new equipment, merchandising and handling function, at various volumes handled, for each elevator model

Elevator model	Volume handled (1,000 bu.)									
	100	150	200	300	400	500	600	800	1,000	1,200
	(dollars)									
Old 30,000-bu wood	14,544	16,615	2/18,372	21,007	22,719	24,583	-	-	-	-
New 30,000-bu. concrete	17,987	20,058	2/21,816	24,451	26,163	28,027	-	-	-	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	15,614	17,685	19,463	2/22,105	23,821	25,684	28,382	31,747	-	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	16,542	18,612	20,434	23,094	2/24,800	26,680	29,397	32,713	37,134	40,470
Old 30,000-bu. + 60,000-bu. concrete	19,685	21,756	23,554	26,206	27,923	2/29,788	32,493	35,810	40,175	-
Old 30,000-bu. + 100,000-bu. concrete	20,159	22,229	24,055	26,718	28,437	30,304	2/33,025	36,338	40,729	44,065
Old 30,000-bu. + two 55,000-bu. flat steel	14,147	16,302	18,292	2/20,954	22,673	24,542	28,062	30,673	-	-
Old 30,000-bu. + 200,000-bu. concrete	-	-	25,370	28,059	29,782	31,659	34,406	2/37,722	42,170	45,451
Old 30,000-bu. + 400,000-bu. concrete	-	-	30,130	32,882	34,618	36,511	39,317	42,634	2/47,271	50,524
	(cents per bushel)									
Old 30,000-bu. wood	14.54	11.08	2/9.19	7.00	5.68	4.92	-	-	-	-
New 30,000-bu. concrete	17.99	13.37	2/10.91	8.15	6.54	5.61	-	-	-	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	15.61	11.79	9.73	2/7.37	5.96	5.14	4.73	3.97	-	-
Old 30,000-bu. + four 25,000-bu. concrete tanks	16.54	12.41	10.22	7.70	2/6.20	5.34	4.90	4.09	3.71	3.37
Old 30,000-bu. + 60,000-bu. concrete	19.68	14.50	11.78	8.74	6.98	2/5.96	5.42	4.48	4.02	-
Old 30,000-bu. + 100,000-bu. concrete	20.16	14.82	12.03	8.91	7.11	6.06	2/5.50	4.54	4.07	3.67
Old 30,000-bu. + two 55,000-bu. flat steel	14.15	10.87	9.15	2/6.98	5.67	4.91	4.68	3.83	-	-
Old 30,000-bu. + 200,000-bu. concrete	-	-	12.68	9.35	7.45	6.33	5.73	2/4.72	4.22	3.79
Old 30,000-bu. + 400,000-bu. concrete	-	-	15.06	10.96	8.65	7.30	6.55	5.33	2/4.73	4.21

1/ Annual fixed expenses were $2,400 higher
2/ Expenses at "base" merchandising and handling volume

Appendix table 15. - Non-operating statement expenses expressed in cents per bushel for the grain storage and grain merchandising and handling functions, by elevator model

Elevator model	Merchandising and handling		Storage	
	Shrinkage and quality deterioration	Interest on long-term capital	Shrinkage and quality deterioration	Interest on long-term capital
	(cents per bushel)			
Old 30,000-bu. wood	.50	.68	.75	-
New 30,000-bu. concrete	.50	1.60	.75	-
Old 30,000-bu. + two 20,000-bu. concrete tanks	.50	.62	.75	5.17
Old 30,000-bu. + four 25,000-bu. concrete tanks	.50	.55	.75	4.05
Old 30,000-bu. + 60,000-bu. concrete	.50	.71	.75	4.50
Old 30,000-bu. + 100,000-bu. concrete	.50	.61	.75	3.88
Old 30,000-bu. + two 55,000-bu. flat steel	.50	.36	2.00	2.74
Old 30,000-bu. + 200,000-bu. concrete	.50	.51	.75	3.71
Old 30,000-bu. + 400,000-bu. concrete	.50	.58	.75	3.54

RELATED PUBLICATIONS

1. Losses from Shrinkage and Quality Deterioration of Corn Stored in Country Elevators and at Bin Sites in Iowa, AMS-173, Agricultural Marketing Service, USDA., 1957.

2. New Local Elevators, Service Report 12, Farmer Cooperative Service, USDA., 1955.

3. Costs of Storing Reserve Stocks of Wheat at Country Elevators and on Farms in Kansas, Marketing Research Report No. 124, Agricultural Marketing Service, USDA., 1956.

4. Costs of Storing Reserve Stocks of Corn in Country Elevators at Bin Sites, and on Farms, Marketing Research Report No. 93, Agricultural Marketing Service, USDA., 1955.

5. New Country Elevators, FCS Circular 10, Farmer Cooperative Service, USDA., 1955.

6. Differences in the Financial Organization and Operation of Country Grain Elevators in the Northern Half of Illinois, 1954-55, AERR-17, University of Illinois College of Agriculture, Urbana, 1957.

7. Marketing Southern Illinois Corn, Wheat, and Soybeans, Bulletin 595, University of Illinois, Agricultural Experiment Station, Urbana, __.

8. Planning Local Elevator and Feed Mill Facilities, Bulletin 783, Ohio Agricultural Experiment Station, Wooster, 1957.

ACKNOWLEDGMENTS

The following persons, firms, and organizations, were among those who supplied helpful information in developing elevator facility costs and other relations for the models used in this study:

J. E. Reeser Company, Maroa, Ill.
Ryan Construction Company, Mt. Pulaski, Ill.
Chalmers & Borton, Hutchinson, Kans.
Roberts Construction Co., Sabetha, Kans.
Prater Pulverizer Company, Chicago, Ill.
Jacobson Machine Works, Minneapolis, Minn.
The Duplex Mill and Manufacturing Company, Springfield, Ohio
Hot Spot Detector, Inc., Des Moines, Iowa
St. Louis Bank for Cooperatives, St. Louis, Mo.
United Grain Company, Champaign, Ill.
Illinois Grain Corporation, Chicago, Ill.
Millers Mutual Fire Insurance Co., Alton, Ill.
George A. Rolfes Company, Boone, Iowa
Dunbar Kapple, Inc., Geneva, Ill.
Illinois Power Company, Champaign, Ill.
Central Illinois Electric and Gas Co., Lincoln, Ill.
Central Illinois Public Service Co., Springfield, Ill.
Stran-Steel Corporation, Detroit, Mich.

Numerous country elevators supplied valuable information on operating and construction costs. The authors are especially indebted to the cooperatively-owned case study elevators who allowed us to delve into the many facets of their operations.